CURRENT INTELLIGENCE BULLETIN 67

Promoting Health and Preventing Disease and Injury Through Workplace Tobacco Policies

Tobacco-Free for Total Worker Health™

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

On the cover: The cover design includes a wispy background image intended to evoke the well-known health hazard of smoke associated with the use of combustible tobacco products, and the much less studied misty emissions associated with the use of electronic devices to "vape" liquids containing nicotine and other components. The full range of hazards associated with tobacco use extends well beyond such air contaminants, so the cover design also incorporates a text box to highlight the optimal "Tobacco-Free" (i.e., not just "Smoke-Free") status for both workplaces and workers. The text box also evokes the NIOSH Total Worker Health™ strategy. This strategy maintains a strong focus on protection of workers against occupational hazards, including exposure to secondhand tobacco smoke on the job, while additionally encompassing workplace health promotion to target lifestyle risk factors, including tobacco use by workers. *Photo by ©Thinkstock*.

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Foreword

Current Intelligence Bulletins (CIBs) are issued by the National Institute for Occupational Safety and Health (NIOSH) to disseminate new scientific information about occupational hazards. A CIB may draw attention to a formerly unrecognized hazard, report new data on a known hazard, or disseminate information about hazard control.

Public health efforts to prevent disease caused by tobacco use have been underway for the past half century, but more remains to be done to achieve a society free of tobacco-related death and disease. The Centers for Disease Control and Prevention (CDC), of which NIOSH is a part, has recently proclaimed a "Winnable Battle" to reduce tobacco use. NIOSH marks a half century since the first Surgeon General's Report on the health consequences of smoking by disseminating this CIB 67, *Promoting Health and Preventing Disease and Injury through Workplace Tobacco Policies*.

Workers who use tobacco products, or who are employed in workplaces where smoking is allowed, are exposed to carcinogenic and other toxic components of tobacco and tobacco smoke. Cigarette smoking is becoming less frequent, and smoke-free and tobacco-free workplace policies are reducing exposure to secondhand smoke (SHS) and motivating smokers to quit—but millions of workers still smoke, and smoking is still permitted in many workplaces. Other forms of tobacco also represent a health hazard to workers who use them. In addition to direct adverse effects of tobacco on the health of workers who use tobacco products or are exposed to SHS, tobacco products used in the workplace—and away from work—can worsen the hazardous effects of other workplace exposures.

This CIB addresses the following aspects of tobacco use:

- Tobacco use among workers.
- Exposure to secondhand smoke in workplaces.
- Occupational health and safety concerns relating to tobacco use by workers.
- Existing occupational safety and health regulations and recommendations prohibiting or limiting tobacco use in the workplace.
- Hazards of worker exposure to SHS in the workplace.
- Interventions aimed at eliminating or reducing these hazards.

This CIB concludes with NIOSH recommendations on tobacco use in places of work and tobacco use by workers.

NIOSH urges all employers to embrace a goal that all their workplaces will ultimately be made and maintained tobacco-free. Initially, at a minimum, employers should take these actions:

- Establish their workplaces as smoke-free (encompassing all indoor areas without exceptions, areas immediately outside building entrances and air intakes, and all work vehicles).

- Assure compliance with OSHA and MSHA regulations that prohibit or otherwise restrict smoking, smoking materials, and/or use of other tobacco products in designated hazardous work areas.
- Provide cessation support for their employees who continue to use tobacco products.
- Doing all this will help fulfill employers' fundamental obligation to provide safe workplaces, and these actions can improve the health and well-being of their workers.

John Howard, M.D.
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Executive Summary

Introduction

Various NIOSH criteria documents on individual hazardous industrial agents, from asbestos [NIOSH 1972] through hexavalent chromium [NIOSH 2013a], have included specific recommendations relating to tobacco use, along with other recommendations to eliminate or reduce occupational safety and health risks. In addition, NIOSH has published two Current Intelligence Bulletins focused entirely on the hazards of tobacco use. CIB 31, *Adverse Health Effects of Smoking and the Occupational Environment*, outlined how tobacco use—most commonly smoking—can increase risk, sometimes profoundly, of occupational disease and injury [NIOSH 1979]. In that CIB, NIOSH recommended that smoking be curtailed in workplaces where those other hazards are present and that worker exposure to those other occupational hazards be controlled. CIB 54, *Environmental Tobacco Smoke in the Workplace: Lung Cancer and Other Health Effects*, presented a determination by NIOSH that secondhand smoke (SHS) causes cancer and cardiovascular disease [NIOSH 1991]. In that CIB, NIOSH recommended that workplace exposures to SHS be reduced to the lowest feasible concentration, emphasizing that eliminating tobacco smoking from the workplace is the best way to achieve that. This current CIB 67, *Promoting Health and Preventing Disease and Injury Through Workplace Tobacco Policies,* augments those two earlier NIOSH CIBs. Consistent with the philosophy embodied in the NIOSH Total Worker Health™ Program [NIOSH 2013b], this CIB is aimed not just at preventing occupational injury and illness related to tobacco use, but also at improving the general health and well-being of workers.

Smoking and Other Tobacco Use by Workers—Exposure to Secondhand Smoke at Work

Millions of workers use tobacco products. Since publication of the first Surgeon General's Report on the health consequences of smoking, cigarette smoking prevalence in the United States has declined by more than 50% among all U.S. adults—from about 42% in 1965 to about 18% in 2013 [DHHS 2014; CDC 2014d]. Overall, smoking among workers has similarly declined, but smoking rates among blue-collar workers have been shown to be consistently higher than among white-collar workers. Among blue-collar workers, those exposed to higher levels of workplace dust and chemical hazards are more likely to be smokers [Chin et al. 2012]. Also, on average, blue-collar smokers smoke more heavily than white-collar smokers [Fujishiro et al. 2012].

From 2004–2011, cigarette smoking prevalence varied widely by industry, ranging from about 10% in education services to more than 30% in construction, mining, and accommodation and food services. Smoking prevalence varies even more by occupation, ranging from 2% among religious workers to 50% among construction trades helpers [NIOSH 2014]. A recent survey of U.S. adults found that by 2013, approximately 1 in 3 current

smokers reported ever having used e-cigarettes, a type of electronic nicotine delivery system (ENDS) [King et al. 2015]. However, the prevalence of ENDS use by industry and occupation has not been studied. Overall, about 3% of all workers use smokeless tobacco in the form of chewing tobacco and snuff, but smokeless tobacco use exceeds 10% among workers in construction and extraction jobs and stands at nearly 20% among workers in the mining industry [NIOSH 2014]. The use of smokeless tobacco by persons who also smoke tobacco products—one form of what is known as "dual use"—is a way some workers maintain their nicotine habit in settings where smoking is prohibited (e.g., in an office where indoor smoking is prohibited or in coal mines where smoking can cause explosions). More than 4% of U.S. workers who smoke cigarettes also use smokeless tobacco [CDC 2014b; NIOSH 2014].

The implementation of smoke-free policies has eliminated or substantially decreased exposure to SHS in many U.S. workplaces. But millions of nonsmoking workers not covered by these policies are still exposed to SHS in their workplace. A 2009–2010 survey found that 20.4% of nonsmoking U.S. workers experienced exposure to SHS at work on at least 1 day during the preceding week [King et al. 2014]. Another survey conducted at about the same time estimated that 10.4% of nonsmoking adult U.S. workers experienced exposure to SHS at work on at least 2 days per week during the past year [Calvert et al. 2013]. Such exposure varied by industry (ranging from 4% for finance and insurance to nearly 28% for mining) and by occupation (ranging from 2% for education, training, and library occupations to nearly 29% for construction and extraction occupations). Inclusion of ENDS in smoke-free policies has increased over time. In the United States, the number of states and localities that explicitly prohibited use of e-cigarettes in public places where tobacco smoking was already prohibited totaled 3 states and more than 200 localities before the end of 2014 [CDC 2014c].

Health and Safety Consequences of Tobacco Use

Since the first Surgeon General's report on smoking and health, many reports from the Surgeon General and other health authorities have documented serious health consequences of smoking tobacco, exposure to secondhand smoke (SHS), and use of smokeless tobacco. Smoking is a known cause of the top five health conditions impacting the U.S. population—heart disease, cancer, cerebrovascular disease, chronic lower respiratory disease, and unintentional injuries [DHHS 2004, 2014]. Smoking also causes a variety of other diseases, as well as adverse reproductive effects [DHHS 2004, 2014]. Smoking is responsible for more than 480,000 premature deaths each year in the U.S. [DHHS 2014]. The risk of most adverse health outcomes caused by smoking is related to the duration and intensity of tobacco smoking, but no level of tobacco smoking is risk free [DHHS 2010b, 2014].

Likewise, there is no risk-free level of exposure to SHS [DHHS 2006, 2014]. SHS exposure causes more than 41,000 deaths each year among U.S. nonsmokers [DHHS 2014]. Among exposed adults, there is strong evidence of a causal relationship between exposure to SHS and a number of adverse health effects, including lung cancer, heart disease (including heart attacks), stroke, exacerbation of asthma, and reduced birth weight of offspring (due to SHS exposure of nonsmoking pregnant women) [DHHS 2006, 2014; IARC 2009; IOM 2010; Henneberger et al. 2011]. In addition, there is suggestive evidence that exposure to SHS causes a range of other health effects among adults, including other cancers (breast cancer, nasal cancer), asthma, chronic obstructive pulmonary disease (COPD), and premature delivery of babies born to women exposed to SHS [DHHS 2006, 2014; IARC 2009].

Because ENDS are relatively new products that vary widely and have not been well studied, limited data are available on potential hazardous effects of active and passive exposures to their emissions [Brown and Cheng 2014; Orr 2014; Bhatnagar et al. 2014]. A recent white paper from the American Industrial Hygiene Association thoroughly reviewed the ENDS issue and cautioned that "… the existing research does not appear to warrant the conclusion that e-cigarettes are "safe" in absolute terms … e-cigarettes should be considered a source of volatile organic compounds (VOCs) and particulates in the indoor environment that have not been thoroughly characterized or evaluated for safety" [AIHA 2014].

Smokeless tobacco is known to cause several types of cancer, including oral, esophageal, and pancreatic cancers [IARC 2012]. Some newer smokeless tobacco products (e.g., snus) are processed in a way intended to substantially reduce toxicant and carcinogen content, though variable residual levels remain even in these newer products and represent potential risk to users [Stepanov et al. 2008]. All smokeless tobacco products contain nicotine, a highly addictive substance which is plausibly responsible for high risks of adverse reproductive outcomes (e.g., low birth weight, pre-term delivery, and stillbirth) associated with maternal use of snus [DHHS 2014].

Combining Tobacco Use and Occupational Hazards Enhances Risk

Many workers and their employers do not fully understand that tobacco use in their workplaces (most commonly smoking) can increase—sometimes profoundly—the likelihood and/or the severity of occupational disease and injury caused by other hazards present. This can occur in various ways. A toxic industrial chemical present in the workplace can also be present in tobacco products and/or tobacco smoke, so workers who smoke or are exposed to SHS are more highly exposed and placed at greater risk of the occupational disease associated with those chemicals.

Heat generated by smoking tobacco in the workplace can transform some workplace chemicals into more toxic chemicals, placing workers who smoke at greater risk of toxicity [NIOSH 1979; DHEW 1979b; DHHS 1985]. Tobacco products can readily become contaminated by toxic workplace chemicals, through contact of the tobacco products with unwashed hands or contaminated surfaces and through deposition of airborne contaminants onto the tobacco products. Subsequent use of the contaminated tobacco products, whether at or away from the workplace, can facilitate entry of these toxic agents into the user's body [NIOSH 1979; DHEW 1979b].

Often, a health effect can be independently caused by tobacco use and by workplace exposure to a toxic agent. For example, tobacco smoking can reduce a worker's lung function, leaving that worker more vulnerable to the effect of any similar impairment of lung function caused by occupational exposure to dusts, gases, or fumes [NIOSH 1979; DHEW 1979b; DHHS 1985]. For some occupational hazards, the combined impact of tobacco use and exposure to a toxic occupational agent can be synergistic (i.e., amounting to an effect profoundly greater than the sum of each independent effect). An example is the combined synergistic effect of tobacco smoking and asbestos exposure on lung cancer, which results in a profoundly increased risk of lung cancer among asbestos-exposed workers who smoke [NIOSH 1979; DHEW 1979b; IARC 2004; Frost et al. 2011; Markowitz et al. 2013].

The risk of occupational injuries and traumatic fatalities can be greatly enhanced when tobacco use is combined with an occupational hazard. Obvious examples are explosions and fires when explosive or flammable materials in the workplace are ignited by sources associated with tobacco smoking [MSHA 2000; OSHA 2013a]. However, any form of tobacco use may result in traumatic injury if the worker operating a vehicle or industrial machinery is distracted by tobacco use (e.g., while opening, lighting, extinguishing, or disposing of a tobacco product) [NIOSH 1979].

Preventive Interventions

Both health and economic considerations can motivate people to quit tobacco use. Workers who smoke can protect their own health by quitting tobacco use and can protect their coworkers' health by not smoking in the workplace. Smokers who quit stand to benefit financially. Among other savings, they no longer incur direct costs associated with consumer purchases of tobacco products and related materials, and they generally pay lower life and health insurance premiums and lower out-of-pocket costs for health care.

Legally determined employer responsibilities set out in federal, state, and local laws and regulations, as well as health and economic considerations, can motivate employers to establish workplace policies that prohibit or restrict tobacco use. Even where smoke-free workplace policies are not explicitly mandated by state or local governments, the general duty of employers to provide safe work environments for their employees can motivate employers to prohibit smoking in their workplaces, thereby avoiding liability for exposing nonsmoking employees to SHS [Zellers et al. 2007]. Also, not only are nonsmoking workers generally healthier, but they are more productive and less costly for employers. Considering aggregate cost and productivity impacts, one recent study estimated that the annual cost to employ a smoker was, on average, nearly $6,000 greater than the cost to employ a nonsmoker [Berman et al. 2013]. It follows that interventions that help smoking workers quit can benefit the bottom line of a business.

Several studies have shown that smoke-free workplace policies decrease exposure of nonsmoking employees to SHS at work, increase smoking cessation, and decrease smoking rates among employees [Fichtenberg and Glantz 2002; Bauer et al. 2005; DHHS 2006; IARC 2009; Hopkins et al. 2010]. Less restrictive workplace smoking policies are associated with higher levels of sustained tobacco use among workers [IARC 2009]. In workplaces without a workplace rule that limits smoking, workers are significantly more likely to be smokers [Ham et al. 2011]. Policies that make indoor workplaces smoke-free result in improved worker health [IARC 2009; Callinan et al. 2010]. For example, smoke-free policies in the hospitality industry have been shown to improve health among bar workers, who are often heavily exposed to SHS in the absence of such policies [Eisner et al. 1998; DHHS 2006; IARC 2009]. Smoke-free policies also reduce hospitalizations for heart attacks in the general population [IARC 2009; IOM 2010; Tan and Glantz 2012; DHHS 2014] and several recent studies suggest that these policies may also reduce hospitalizations and emergency department visits for asthma in the general population [Hahn 2010; Mackay et al. 2010; Tan and Glantz 2012; Herman and Walsh 2011]. The CDC-administered Task Force on Community Preventive Services recommends smoke-free workplace policies, not only to reduce exposure to SHS, but also to increase tobacco cessation, reduce tobacco use prevalence, and reduce tobacco-related morbidity and mortality [Hopkins et al. 2010; Task Force on Community Preventive Services 2010; GCPS 2012a].

Some employers have taken action to extend restrictions on tobacco use by their employees beyond the workplace, for example by prohibiting smoking by workers during their workday breaks, when away from the workplace, including during lunchtime. Several large employers have gone further by barring the hiring of smokers. Such wide-ranging policies generate substantial controversy and are illegal in some jurisdictions [Asch et al. 2013; Schmidt et al. 2013].

Workplace Tobacco Use Cessation Programs

Employees who smoke and want to quit can benefit from employer-provided resources and assistance. Various levels and types of cessation support can be provided to workers, though more intensive intervention has a greater effect [Clinical Practice Guideline 2008]. Occupational health providers and worksite health promotion staff can increase quit rates simply by asking about a worker's tobacco use and offering brief counseling [O'Hara et al. 1993; Clinical Practice Guideline 2008]. Workers who smoke can be referred to publicly funded state quitlines, which have been shown to increase tobacco cessation success [GCPS 2012b; Clinical Practice Guideline 2008]. Widespread availability, ease of accessibility, affordability, and potential reach to populations with higher levels of tobacco use make quitlines an important component of any cessation effort [Clinical Practice Guideline 2008]. However, many employers do not make their employees aware of them [Hughes et al. 2011]. Mobile phone texting interventions and web-based interventions are also promising approaches to assist with tobacco cessation [Graham et al. 2007; Clinical Practice Guideline 2008; Whittaker et al. 2011; Civljak et al. 2013]. The most comprehensive workplace cessation programs incorporate tobacco cessation support into programs that address the overall safety, health, and well-being of workers. A growing evidence base supports the enhanced effectiveness of workplace health promotion programs when they are combined with occupational health protection programs [Sorensen et al. 2003; Barbeau et al. 2006; Hymel et al. 2011; NIOSH 2013b].

Health Insurance and Smoking—Using Incentives and Disincentives to Modify Tobacco Use Behavior

Many workers are covered by employer-provided health insurance, which is increasingly being designed to encourage and help employees to adopt positive personal health-related behaviors, including smoking cessation for smokers. Health insurance coverage of evidence-based smoking cessation treatments is associated with increases in the number of smokers who attempt to quit, use proven treatments in these attempts, and succeed in quitting [Clinical Practice Guideline 2008]. Ideally, such coverage should provide access to all evidence-based cessation treatments, including individual, group, and telephone counseling, and all seven FDA-approved cessation medications, while eliminating or minimizing barriers such as cost-sharing and prior authorization [Clinical Practice Guideline 2008; CDC 2014b].

The Affordable Care Act (ACA), Public Law 111-148, includes provisions pertinent to tobacco use and cessation [McAfee et al. 2015]. Some of these provisions are intended to help smokers quit by increasing their access to proven cessation treatments. Other ACA provisions are intended to encourage tobacco cessation by permitting small-group plans to charge tobacco users premiums that are up to 50% higher than those charged to non-tobacco users, subject certain limitations [78 Fed. Reg. 33158].

The appropriate intent of incentives is to help employees who use tobacco quit, thus improving health and reducing health-care costs overall. The evidence for the effectiveness of imposing insurance premium surcharges on tobacco users is limited, and care is needed to ensure that incentive programs are designed to work as intended and to minimize the potential use of incentives in an unduly coercive or discriminatory manner [Madison et al. 2011, 2013]. The Task Force on Community Preventive Services has recommended worksite-based incentives and competitions that are combined with other evidence-based interventions (e.g., education, group support, telephonic counseling, self-help materials, smoke-free workplace policies) as part of a comprehensive cessation program [GCPS 2005].

Conclusions

- Cigarette smoking by workers and SHS exposure in the workplace have both declined substantially over recent decades, but about 20% of all U.S. workers still smoke and about 20% of nonsmoking workers are still exposed to SHS at work.
- Smoking prevalence among workers varies widely by industry and occupation, approaching or exceeding 30% in construction, mining, and accommodation and food services workers.
- Prevalence of ENDS use by occupation and industry has not been studied, but ENDS has grown greatly, with about 1 in 3 current U.S. adult smokers reporting ever having used e-cigarettes by 2013.
- Smokeless tobacco is used by about 3% of U.S. workers overall, but smokeless tobacco is used by more than 10% workers in construction and extraction jobs and by nearly 20% of workers in the mining industry, which can be expected to result in disparities in tobacco-related morbidity and mortality.
- Tobacco use causes debilitating and fatal diseases, including cancer, respiratory diseases, and cardiovascular diseases. These diseases afflict mainly users, but they also occur in those exposed to SHS. Smoking is substantially more hazardous, but use of smokeless tobacco also causes adverse health effects. More than 16 million U.S. adults live with a disease caused by smoking, and each year nearly a half million die prematurely from smoking or exposure to SHS.
- Tobacco use is associated with increased risk of injury and property loss due to fire, explosion, and vehicular collisions.
- Tobacco use by workers can increase, sometimes profoundly, the likelihood and the severity of occupational disease and injury caused by other workplace hazards (e.g., lead, asbestos, and flammable materials).
- Restrictions on smoking and tobacco use in specific work areas where particular high-risk occupational hazards are present (e.g., explosives, highly flammable materials, or highly toxic materials that could be ingested via tobacco use) have long been used to protect workers.
- A risk-free level of exposure to SHS has not been established, and ventilation is insufficient to eliminate indoor exposure to SHS.
- Potential adverse health effects associated with using ENDS or secondhand exposure to particulate aerosols and gases emitted from ENDS remains to be fully characterized.

- Policies that prohibit tobacco smoking throughout the workplace (i.e., smoke-free workplace policies) are now widely implemented, but they have not yet been universally adopted across the United States. These policies improve workplace air quality, reduce SHS exposure and related health effects among nonsmoking employees, increase the likelihood that workers who smoke will quit, decrease the amount of smoking during the working day by employees who continue to smoke, and have an overall impact of improving the health of workers (i.e., among both nonsmokers who are no longer exposed to SHS on the job and smokers who quit).
- Workplace-based efforts to help workers quit tobacco use can be easily integrated into existing occupational health and wellness programs. Even minimal counseling and/or simple referral to state quitlines, mobile phone texting interventions, and web-based intervention can be effective, and more comprehensive programs are even more effective.
- Integrating both occupational safety and health protection components into workplace health promotion programs (e.g., smoking cessation) can increase participation in tobacco cessation programs and successful cessation among blue-collar workers.
- Smokers, on average, are substantially more costly to employ than nonsmokers.
- Some employers have policies that prohibit employees from using tobacco when away from work or that bar the hiring of smokers or tobacco users. However, the ethics of these policies remain under debate, and they may be legally prohibited in some jurisdictions.

Recommendations

NIOSH recommends that employers take the following actions related to employee tobacco use:

- At a minimum, establish and maintain smoke-free workplaces that protect those in workplaces from involuntary, secondhand exposures to tobacco smoke and airborne emissions from e-cigarettes and other electronic nicotine delivery systems. Ideally, smoke-free workplaces should be established in concert with tobacco cessation support programs. Smoke-free zones should encompass (1) all indoor areas without exceptions (i.e., no indoor smoking areas of any kind, even if separately enclosed and/or ventilated), (2) all areas immediately outside building entrances and air intakes, and (3) all work vehicles. Additionally, ashtrays should be removed from these areas.
- Optimally, establish and maintain entirely tobacco-free workplaces, allowing no use of any tobacco products across the entire workplace campus (see model policy in Box 6-1).
- Comply with current OSHA and MSHA regulations that prohibit or limit smoking, smoking materials, and/or use of other tobacco products in work areas characterized by the presence of explosive or highly flammable materials or potential exposure to toxic materials (see Table A-3 in the Appendix). To the extent feasible, follow all similar NIOSH recommendations (see Table A-2 in the Appendix).
- Provide information on tobacco-related health risks and on benefits of quitting to all employees and other workers at the worksite (e.g., contractors and volunteers).
    - Inform all workers about health risks of tobacco use.

  - Inform all workers about health risks of exposure to SHS.
  - Train workers who are exposed or potentially exposed to occupational hazards at work about increased health and/or injury risks of combining tobacco use with exposure to workplace hazards, about what the employer is doing to limit the risks, and about what the worker can do to limit his/her risks.
- Provide information on employer-provided and publicly available tobacco cessation services to all employees and other workers at the worksite (e.g., contractors and volunteers).
  - At a minimum, include information on available quitlines, mobile phone texting interventions, and web-based cessation programs, self-help materials, and employer-provided cessation programs and tobacco-related health insurance benefits available to the worker.
  - Ask about personal tobacco use as part of all occupational health and wellness program interactions with individual workers and promptly provide encouragement to quit and guidance on tobacco cessation to each worker identified as a tobacco user and to any other worker who requests tobacco cessation guidance.
- Offer and promote comprehensive tobacco cessation support to all tobacco-using workers and, where feasible, to their dependents.
  - Provide employer-sponsored cessation programs at no cost or subsidize cessation programs for lower-wage workers to enhance the likelihood of their participation. If health insurance is provided for employees, the health plan should provide comprehensive cessation coverage, including all evidence-based cessation treatments, unimpeded by co-pays and other financial or administrative barriers.
  - Include occupational health protection content specific to the individual workplace in employer-sponsored tobacco cessation programs offered to workers with jobs involving potential exposure to other occupational hazards.
- Become familiar with available guidance (e.g., CDC's "Implementing a Tobacco-Free Campus Initiative in Your Workplace") (see Box 6-2) and federal guidance on tobacco cessation insurance coverage under the ACA (e.g., http://www.dol.gov/ebsa/faqs/faq-aca19.html) before developing, implementing, or modifying tobacco-related policies, interventions, or controls.
- Develop, implement, and modify tobacco-related policies, interventions, and controls in a stepwise and participatory manner. Get input from employees, labor representatives, line management, occupational safety/health and wellness staff, and human resources professionals. Those providing input should include current and former tobacco users, as well as those who have never used tobacco. Seek voluntary input from employees with health conditions, such as heart disease and asthma, exacerbated by exposure to SHS.
- Make sure that any differential employment benefits policies that are based on tobacco use or participation in tobacco cessation programs are designed with a primary intent to improve worker health and comply with all applicable federal, state, and local laws and regulations. Even when permissible by law, these differential employment benefit policies—as well as differential hiring policies based on tobacco use—should be implemented only after seriously considering ethical concerns and possible

unintended consequences. These consequences can include the potential for adverse impacts on individual employees (e.g., coercion, discrimination, and breach of privacy) and the workforce as a whole. Furthermore, the impact of any differential policies that are introduced should be monitored to determine whether they improve health and/or have unintended consequences.

NIOSH recommends that workers who smoke cigarettes or use other tobacco products take the following actions:

- Comply with all workplace tobacco policies.
- Ask about available employer-provided tobacco cessation programs and cessation-related health insurance benefits.
- Quit using tobacco products. Know that quitting tobacco use is beneficial at any age, but the earlier one quits, the greater the benefits. Many people find various types of assistance to be very helpful in quitting, and evidence-based cessation treatments have been found to increase smokers' chances of quitting successfully. Workers can get help from
  - tobacco cessation programs, including web-based programs (e.g., http://smokefree.gov and http://www.cdc.gov/tips) and mobile phone texting services (e.g., the SmokefreeTXT program, http://smokefree.gov/smokefreetxt);
  - state quitlines (phone: 1-800-QUIT-NOW [1-800-784-8669], or 1-855-DEJELO-YA [1-855-335-3569 for Spanish-speaking callers]); and/or
  - health-care providers.

In addition, individual workers who want to quit tobacco may find several of the websites listed in Box 6-2 helpful.

NIOSH recommends that all workers, including workers who use tobacco and nonsmokers exposed to SHS at their workplace:

- know the occupational safety and health risks associated with their work, including those that can be made worse by personal tobacco use, and how to limit those risks; and
- consider sharing a copy of this CIB with their employer.

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Contents

Abbreviations

ACA	Affordable Care Act
CDC	Centers for Disease Control and Prevention
CIB	Current Intelligence Bulletin
COPD	chronic obstructive pulmonary disease
ENDS	electronic nicotine delivery system
FDA	Food and Drug Administration
MSHA	Mine Safety and Health Administration
NHIS	National Health Interview Survey
NIOSH	National Institute for Occupational Safety and Health
OEL	occupational exposure limit
OSHA	Occupational Safety and Health Administration
SHS	secondhand smoke
SIDS	sudden infant death syndrome

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1 Background

The widespread recognition that tobacco use is the leading preventable cause of premature death and a major cause of preventable disease, injury, and disability in the United States is based on an extraordinarily strong scientific foundation. The first Surgeon General's report on smoking and health, issued a half century ago, concluded that cigarette smoke causes lung cancer and chronic bronchitis [DHEW 1964]. Subsequent reports of the Surgeon General have determined that both active tobacco smoking and secondhand smoke (SHS) exposure are important causes of cancer, heart disease, and respiratory disease, and that smokeless tobacco use also causes serious disease, including oral, esophageal, and pancreatic cancer [e.g., DHHS 1982; 1983; 1984; 1986a,b; 2004; 2006; 2014]. One Surgeon General's report focused entirely on smoking-enhanced risks of cancer and chronic lung disease for workers exposed to hazardous industrial agents in the workplace [DHHS 1985]. Several reports of the Surgeon General have addressed benefits of effective smoking cessation programs and other means of reducing tobacco use [DHHS 1990, 2000, 2012, 2014].

A Surgeon General's report also established the ongoing *Healthy People* strategy, aimed broadly at improving the nation's health [DHEW 1979a]. Currently, *Healthy People 2020* includes a major goal of reducing "illness, disability, and death related to tobacco use and secondhand smoke exposure" along with several specific objectives that target eliminating tobacco smoking in workplaces [DHHS 2013]. The Centers for Disease Control and Prevention has declared reducing tobacco use a "Winnable Battle," noting that tobacco use is one of several "public health priorities with large-scale impact on health and with known, effective strategies to address them" [CDC 2013a]. The U.S. Department of Health and Human Services has published a strategic plan for tobacco control that envisions "a society free of tobacco-related death and disease" [DHHS 2010a].

Over time, National Institute for Occupational Safety and Health (NIOSH) publications have evolved in how they have acknowledged and made recommendations about hazards associated with tobacco use by workers. The first criteria document published by NIOSH—on asbestos—only briefly mentioned smoking. Smoking was addressed in the context of a discussion of research findings that concluded that smoking alone could not explain the extremely high risk of lung cancer observed in asbestos-exposed workers. Smoking was also mentioned in a suggestion that the medical monitoring recommended by NIOSH for asbestos-exposed workers would offer opportunity for various forms of individualized medical management, including smoking cessation [NIOSH 1972] (see Appendix Table A-2). Nearly a decade later, after substantially more research on asbestos had been published, NIOSH disseminated a document affirming synergistic (i.e., more than additive) effects on lung cancer risk of combined exposure to asbestos and smoking [NIOSH 1980].

In the late 1970s, NIOSH scientists authored a chapter on "The Interaction between Smoking and Occupational Exposure" in the 1979 Surgeon General's Report on Smoking and Health [DHEW 1979b]. That work led directly to the first NIOSH publication focused solely on tobacco smoke, a Current Intelligence Bulletin (CIB) that outlined several ways in which tobacco use can increase, sometimes profoundly, the risk of occupational disease and injury [NIOSH 1979]. In that CIB, NIOSH recommended that smoking be curtailed in workplaces where those other hazards are present and that worker exposure to those other occupational hazards be controlled (see Appendix Table A-1).

Later, when scientific evidence became clear that the health risk from inhaling tobacco smoke is not limited to smokers but also affects bystanders, NIOSH published another CIB focused solely on tobacco smoke—this one on SHS in the workplace [NIOSH 1991]. In that CIB, NIOSH presented its determination that SHS (referred to in that document as "environmental tobacco smoke") causes cancer and cardiovascular disease. In recommending that workplace exposures to SHS be reduced to the lowest feasible concentration using all available preventive measures, NIOSH emphasized that the best approach is to eliminate tobacco smoking in the workplace, and it endorsed employer-provided smoking cessation programs for employees who smoke [NIOSH 1991] (see Appendix Table A-1).

In retrospect, the CIB on SHS in the workplace marked a watershed in the Institute's approach to occupational safety and health. Over time, NIOSH recommendations concerning specific industrial hazards—which earlier might have been relatively silent about what were then narrowly understood to be strictly personal health-related behaviors like smoking—have come to embrace a more comprehensive preventive approach. This evolution has been motivated by a better understanding of how tobacco use adversely impacts occupational diseases and injuries and—perhaps just as importantly—by a changing societal view of the health and economic consequences of tobacco use. By way of example, criteria documents produced in the past decade on two lung hazards—refractory ceramic fibers [NIOSH 2006] and hexavalent chromium [NIOSH 2013a]—have included entire sections on smoking cessation, something not seen in earlier criteria documents (see Appendix Table A-2). In a 2004 medical journal paper, the Director of NIOSH concluded that "Smoking is an occupational hazard, both for the worker who smokes and for the nonsmoker who is exposed to [SHS] in his or her workplace." He also recommended that "Smoking as an occupational hazard should be completely eliminated for the sake of the health and safety of American workforce" [Howard 2004]. A 2010 post on the NIOSH Blog site pointed out that "Tobacco-free workplaces, on-site tobacco cessation services, and comprehensive, employer-sponsored healthcare benefits that provide multiple quit attempts, have all been shown to increase tobacco treatment success" [Howard et al. 2010].

Thus, instead of staying focused nearly exclusively on protecting workers from specific occupational hazards, NIOSH has progressively adopted a "strategy integrating occupational safety and health protection with health promotion to prevent worker injury and illness and to advance health and well-being" [NIOSH 2013b]. This integrated approach, embodied by NIOSH in its Total Worker Health™ Program [Schill and Chosewood 2013], has motivated NIOSH to produce this CIB, *Promoting Health and Preventing Disease and Injury through Workplace Tobacco Policies*.

2 Tobacco Use by Workers and Secondhand Smoke Exposures at Work

Use of Conventional Tobacco Products by Workers

Tobacco Smoking

Since publication of the first Surgeon General's report on the health consequences of smoking, cigarette smoking prevalence has decreased substantially among U.S. adults, from 42.4% in 1965 to 17.8% in 2013 [DHHS 2014; CDC 2014d]. Nationally representative studies on the smoking status of workers in the United States, most often based on one or more iterations of the National Health Interview Survey (NHIS), have demonstrated substantial declines in overall cigarette smoking, which are similar to the decrease in cigarette smoking among all U.S. adults [Sterling and Weinkam 1976; Nelson et al. 1994; Lee et al. 2004, 2007; Barbeau et al. 2004]. The overall prevalence of current cigarette smoking among workers during the 2004–2010 period was 19.6%, very closely approximating the prevalence among all U.S. adults, which annually ranged from a high of 20.9% to a low of 19.3% during the 2004–2010 period [CDC 2011a, 2013b].

During the past several decades, a number of studies have assessed smoking habits among U.S. workers. Consistently, these studies have shown substantially higher cigarette smoking prevalence among blue-collar workers compared with white-collar workers, particularly among males [Sterling and Weinkam 1976; DHHS 1985; Stellman et al. 1988; Brackbill et al. 1988; Covey et al. 1992; Nelson et al. 1994; Bang and Kim 2001; Barbeau et al. 2004; Lee et al. 2004, 2007; CDC 2011a; Calvert et al. 2013]. In addition, these studies provide evidence of higher intensity of smoking among blue-collar workers who smoke than white-collar workers who smoke [Fujishiro et al. 2012]. Among blue-collar workers, those with higher levels of exposure to dust and chemical hazards are more likely to be smokers [Chin et al. 2012].

NIOSH publishes recent data on cigarette smoking status by industry and occupation groupings in the Work-Related Lung Disease (WoRLD) Surveillance Report and corresponding online updates [NIOSH 2008a, 2014]. The most recent tables, covering the period 2004–2011, show that smoking prevalence varies widely—nearly four-fold—by industry. Smoking prevalence at or below 10% was found among major industry sectors in education services (9.8%) and among minor industry sectors in religious, grantmaking, civic, labor, professional, and similar organizations (10.0%). Smoking prevalence exceeding 30% was found among three major industry sectors: construction (32.1%); accommodation and food services (32.1%); and mining (30.2%). Several minor sectors in other major industries also exceeded 30%: gasoline stations (37.6%); fishing, trapping, and hunting (34.3%); forestry and logging (32.9%); warehousing and storage (32.0%); rental and leasing services (31.3%); wood product manufacturing (30.7%); and nonmetallic mineral product manufacturing (30.4%). Additional tables posted on that same NIOSH site show that cigarette smoking prevalence varies even more extremely—25-fold—by specific occupational group, from 2.0% for religious workers to 49.5% for construction trades helpers [NIOSH 2014] (see Appendix Figures A-1a and A-1b).

Smokeless Tobacco

Smokeless tobacco is not burned when used. Types of smokeless tobacco include chewing tobacco,

snuff, dip, snus, and dissolvable tobacco products. As with smoking, NHIS data have been used to estimate smokeless tobacco use by workers [Dietz et al. 2011; NIOSH 2014]. During 2010, an estimated 3% of currently working adults used smokeless tobacco in the form of chewing tobacco or snuff. Smokeless tobacco use ranged up to 11% for those working in construction and extraction jobs and more than 18% for those working in the mining industry [CDC 2014a; NIOSH 2014]. (Appendix Figures A-2a and A-2b display prevalence of smokeless tobacco use for major industry and occupation categories.)

Dual Use

Someone who smokes cigarettes and also uses smokeless tobacco engages in "dual use." This is one way smokers can try to maintain their nicotine habit when and where smoking is prohibited. Based on 2010 NHIS data, more than 4% of U.S. adult workers who smoke cigarettes also use smokeless tobacco in the form of snuff or chewing tobacco [CDC 2014a; NIOSH 2014]. Dual use has traditionally been practiced by many workers, including coal miners and others, employed in mines or factories where smoking poses risks for explosion and fire [Mejia and Ling 2010]. (Appendix Figures A-3a and A-3b display prevalence of dual use among U.S. adult workers who are current smokers for major industry and occupation categories, respectively.) Use of electronic cigarettes by persons who also smoke is another form of "dual use" that is becoming more prevalent as electronic cigarette use increases (see below, under "Electronic Nicotine Delivery Systems").

Secondhand Smoke Exposures at Work

SHS is a mixture of the "sidestream smoke" emitted directly into the air by the burning tobacco product and the "mainstream smoke" exhaled by smokers while smoking. Workplace exposures to SHS have been demonstrated by using air monitoring and through the use of biological markers, such as cotinine, a metabolite of nicotine [Hammond et al. 1995; Hammond 1999; Achutan et al. 2011; Pacheco et al. 2012]. By the late 1990s, studies that objectively measured markers of SHS found levels that varied substantially by workplace. Where smoking was allowed, offices and blue-collar workplaces had similar concentrations of nicotine in the air; higher nicotine concentrations were present in restaurants, and still higher concentrations (an order of magnitude higher than in offices) were measured in bars [Hammond 1999]. More recently, in studies involving nonsmoking card dealers at three casinos where smoking was prevalent, objective evidence of absorption of a cancer-causing component of SHS (a tobacco-specific nitrosamine) was documented by showing significant increases in urine levels of a metabolite of that component over a work shift [Achutan et al. 2011]. A comprehensive review of research on SHS exposures in casinos has been published elsewhere [Babb et al. 2015].

Smoke-free workplace policies have been increasingly implemented over the past several decades in the United States and have been shown to be effective in reducing exposure to SHS [DHHS 2006, 2014]. In a 1986 survey of the civilian U.S. population, only 3% of employed respondents reported working under a smoke-free workplace policy [CDC 1988]. Subsequent surveys carried out in the 1990s tracked an increasing proportion of indoor workers who reported that they worked under a smoke-free workplace policy—46.5% in 1993, 63.7% in 1996, and 69.3% by 1999 [Shopland et al. 2004]. The 1999 survey found wide disparities; although smoke-free workplace policies covered 90% of school teachers, they covered only 43% of food preparation and service workers, and only 13% of bartenders [Shopland et al. 2004].

Although establishment of smoke-free workplace policies continues to progress in the United States, these policies are not always 100% effective. A 2009–2010 nationwide survey found that, among employed nonsmoking adults in the United States whose workplaces were covered by an indoor smoke-free policy, 16.4% reported exposure to

SHS at work 1 or more days during the past 7 days [King et al. 2014]. Still, this favorably compared with the much greater 51.3% of those not covered by smoke-free policies who reported such exposure to SHS at work [King et al. 2014].

The 2009–2010 nationwide survey also found that 20.4% of nonsmoking employed adults reported SHS exposure in their indoor workplace on 1 or more days during the past 7 days [King et al. 2014]. An analysis of recent NHIS data that used a more restrictive definition of SHS exposure—exposure to SHS at work on 2 or more days per week during the past year—estimated that 10.0% of nonsmoking U.S. workers reported frequent exposure to SHS at work [Calvert et al. 2013]. Prevalence of such frequent exposure by major industry sector ranged from 4.1% for finance and insurance to 28.4% for mining, while prevalence by major occupation ranged from 2.3% for education, training, and library occupations to 28.5% for "construction and extraction" occupations (See Appendix Figures A-4a and A-4b).

Data from 14 state-based population surveys conducted in 2005 indicated that the majority of all indoor workers reported a completely smoke-free workplace policy at their place of employment. State-specific proportions ranged from 54.8% (Nevada) to 85.8% (West Virginia), with a median of 73.4% [CDC 2006]. Results from later surveys conducted by 13 states in 2008 found proportions of nonsmoking employed adults who reported SHS exposure on 2 or more days during the past 7 days in their indoor workplace ranging from 6.0% (Tennessee) to 15.8% (Mississippi), with a state-specific median of 8.6% [CDC 2009]. An even more recent survey involving all states found proportions of nonsmoking employed adults who reported SHS exposure on 1 or more days during the past 7 days in their indoor workplace ranging from 12.4% (Maine) to 30.8% (Nevada) [King et al. 2014].

Prevalences of SHS exposure at work on 1 or more days during the past 7 days were significantly higher among males (23.8%) than females (16.7%), among those without a high school diploma (31.9%) than those with a graduate school degree (11.9%), and among those with an annual household income less than $20,000 (24.2%) than those with ≥ $100,000 income (14.8%). A recent study separated effects on workplace SHS exposure associated with education and income from effects associated with occupation [Fujishiro et al. 2012]. Even after statistically adjusting for the effects of education and income, blue-collar workers were more likely to report workplace SHS exposure than managers and professionals. That same study also found that blue-collar workers were also more likely to be smokers and more likely to be heavy smokers, suggesting that SHS exposures in the workplace could be intense for many blue-collar workers.

Electronic Nicotine Delivery Systems

First introduced into the U.S. market in 2007 [Regan et al. 2013], electronic nicotine delivery systems (ENDS), which include electronic cigarettes, or e-cigarettes, are rapidly increasing in use [King et al. 2015]. The ENDS marketplace has diversified in recent years and now includes multiple products, including electronic hookahs, vape pens, electronic cigars, and electronic pipes. Typically, an ENDS product has a cartridge containing a liquid consisting of varying amounts of nicotine, a propylene glycol and/or glycerin carrier, and flavorings. Inhalation draws the fluid to a heating element, creating vapor that subsequently condenses into an aerosol of minute droplets [Ingebrethsen et al. 2012].

Available data suggest that e-cigarette use has increased greatly in the United States during the past several years. A mail survey of U.S. adults showed that the percentage who had ever used e-cigarette more than quadrupled from 0.6% in 2009 to 2.7% in 2010 [Regan et al. 2013]. A more recent survey of U.S. adults found that by 2013 approximately 1 in 3 current smokers reported ever having used e-cigarettes [King et al. 2015]. To date, there have been no nationally representative surveys of ENDS use specifically among workers or specifically in the workplace.

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3 Health and Safety Consequences of Tobacco Use

Health Problems Caused by Use of Tobacco Products

Tobacco Smoking

Smoking is a known cause of the top five health conditions impacting the U.S. population—heart disease, cancer, cerebrovascular disease, chronic lower respiratory disease, and unintentional injuries [DHHS 2004] (Table 3-1), and each of these is amenable to preventive intervention [Task Force on Community Preventive Services 2010]. The risk and severity of most adverse health outcomes caused by smoking are directly related to the duration and intensity of tobacco smoking, but no level of tobacco smoking is risk-free [DHHS 2010b, 2014]. Smoking is responsible for more than 480,000 deaths each year in the United States [DHHS 2014]. It is estimated that more than 16 million U.S. adults live with chronic obstructive pulmonary disease or other disease attributable to tobacco smoking [DHHS 2014].

Table 3-1. Some health conditions caused by active tobacco smoking

General disease category	Site or specific health condition
Cancers	Lung Bladder Esophageal Laryngeal Oral and throat Cervical Kidney Pancreatic Liver Stomach Colorectal Acute myeloid leukemia
Cardiovascular disease	Atherosclerosis Coronary heart disease Cerebrovascular disease (stroke) Abdominal aortic aneurysm
Lung disease	Chronic obstructive pulmonary disease Acute respiratory infections, including pneumonia Asthma exacerbation Tuberculosis Asthmatic and other respiratory symptoms Accelerated lung function decline

Table 3-1 (Continued). Some health conditions caused by active tobacco smoking

General disease category	Site or specific health condition
Reproductive effects	Reduced fertility
	Placental abnormalities
	Ectopic pregnancy
	Impaired fetal development and congenital orofacial defects
	Premature delivery
	Low birth weight
	Sudden infant death syndrome (SIDS)
	Erectile dysfunction
Other diseases or conditions	Cataracts, macular degeneration, and blindness
	Low bone density and hip fractures
	Poor wound healing
	Peptic ulcer disease
	Periodontitis
	Diabetes
	Rheumatoid arthritis
	Impaired immune function
	General poor health

Source: DHHS [2004, 2014]

Cancer

Smoking is estimated to cause nearly 164,000 cancer deaths among smokers each year in the United States [DHHS 2014]. Cancers caused by smoking include lung, mouth, throat, bladder, and other cancers (Table 3-1). Among the carcinogens present in cigarette smoke are polycyclic aromatic hydrocarbons; N-nitrosamines; aromatic amines; 1,3-butadiene; benzene; aldehydes; and ethylene oxide. In addition to directly causing cancer, smoking can synergistically interact with occupational exposures known to separately cause cancer, leading to effects on cancer causation greater than the effects of the two factors separately [Wraith and Mengersen 2007; Frost et al. 2011; Markowitz et al. 2013] (see Box 3-1).

Cardiovascular Disease

Cigarette smoking is estimated to cause nearly 125,000 heart disease deaths among smokers each year in the United States [DHHS 2014]. The constituents of tobacco smoke believed to be responsible for causing cardiovascular disease include oxidizing chemicals, nicotine, carbon monoxide, and particulate matter. Coronary heart disease (ischemic heart disease) makes up the majority of those heart disease deaths. Cerebrovascular disease (vascular disease in the brain), which can cause strokes, is also a major cause of death from smoking. Smoking also causes aortic aneurysms and peripheral arterial disease. Smoking is estimated to cause nearly 27,000 cerebrovascular and peripheral vascular deaths among smokers each year in the United States [DHHS 2014]. Even low levels of exposure to tobacco smoke—such as a smoking only a few cigarettes per day, occasional smoking, or exposure to SHS—are enough to greatly increase risk of cardiovascular events [DHHS 2010b].

Lung Disease

Cigarette smoking is estimated to cause more than 113,000 deaths among smokers each year in the

Box 3-1. Lung Cancer Risk in Insulators—Effects of Smoking, Asbestos Exposure, and Asbestosis

Cigarette smoking and exposure to asbestos are each well-known causes of lung cancer. Many studies have assessed lung cancer risk among persons who have both smoking and asbestos exposure as risk factors. Frost et al. [2011] confirmed the long-standing view that cigarette smoking raises the risk of death from lung cancer among asbestos-exposed workers in a manner that is greater than additive, if not multiplicative. Results of the study by Markowitz et al. [2013] illustrate effects of smoking combined not just with asbestos exposure, but also specifically with asbestosis (a fibrotic lung disease caused by asbestos). Markowitz et al. reported a long-term mortality study of 2,377 asbestos-exposed insulators identified in 1967 and 54,243 contemporaneous blue-collar workers with little, if any, asbestos exposure. The insulators were divided into two subgroups—one with and the other without radiographic evidence of asbestosis—with roughly equivalent asbestos exposure. Separate lung cancer risks were 10.3-fold for smoking (without asbestos exposure), 3.6-fold for asbestos exposure (without smoking), and 7.4-fold for asbestosis (without smoking). Combined lung cancer risks were 14.4-fold for smoking combined with asbestos exposure and 36.5-fold for smoking combined with asbestosis. The former illustrates an apparent additive effect, because the combined effect was about what would be expected by adding the separate risks for smoking and asbestos exposure. The latter illustrates an apparent supra-additive (i.e., synergistic) effect, because the combined effect is substantially greater than what would be expected by adding the separate risks for smoking and asbestosis.

United States from non-malignant lung diseases [DHHS 2014]. Some of the chemical pathways by which tobacco smoke produces lung damage have been well characterized. It is likely that familial or genetic factors influence susceptibility to the adverse effects of tobacco smoke. Chronic obstructive pulmonary disease (COPD), a broad designation encompassing bronchitis, emphysema, and airways obstruction, accounts for most smoking-caused respiratory deaths. As noted above, the effects of occupational exposure to agents that are toxic to the lung can combine with the adverse health effects of tobacco smoke to cause lung disease of greater severity than that expected from either of the exposures alone (see Box 3-2). Although smoking is the single most common cause of COPD, occupational exposures—often combined with smoking—play a role in causing about 10% to 20% of all COPD cases [Balmes et al. 2003]. In addition, smoking causes exacerbation of asthma, greater susceptibility to infectious pneumonias, and higher risk of tuberculosis [DHHS 2014].

Reproductive and Developmental Effects

Inhalation of tobacco smoke affects the reproductive system, with harmful effects related to fertility, fetal and child development, and pregnancy outcome. Smoking is estimated to cause more than 1,000 deaths from perinatal conditions each year in the United States [DHHS 2014]. Exposure to the complex chemical mixture of combustion compounds in tobacco smoke—including carbon monoxide, which binds to hemoglobin and can deprive the fetus of oxygen—has been found to contribute to a wide range of reproductive effects in women. These effects include altered menstrual cycle and reduced fertility; placental abnormalities and preterm delivery; reduced birth weight, stillbirth, neonatal death, and sudden infant death syndrome (SIDS) in their offspring; earlier and more symptomatic menopause; and other effects [DHHS 2001, 2004, 2014; Soares and Melo 2008; Sadeu et al. 2010]. Smoking by men causes erectile dysfunction [McVary et al. 2001; DHHS 2014], which can also impair reproduction.

Box 3-2. Emphysema Risk in Coal Miners—Effects of Tobacco Smoking and Coal Mine Dust Exposure

A study [Kuempel et al. 2009] evaluated the effects of exposure to coal mine dust, cigarette smoking, and other factors on the severity of lung disease (emphysema) among more than 700 deceased persons, including more than 600 deceased coal miners. The study found that combined occupational exposure to coal mine dust and cigarette smoking had an additive effect on the severity of emphysema among the coal miners. Among smokers and never-smokers alike, emphysema was generally more severe among those who had higher levels of exposure to coal mine dust. However, at any given level of dust exposure, miners who had smoked generally had worse emphysema than miners who had not smoked.

Other Adverse Effects

Smoking is known to cause other health problems that contribute to the generally poorer health of smokers as a group. These include visual difficulties (due to cataracts and age-related macular degeneration), hip fractures (due to low bone density), peptic ulcer disease, diabetes, rheumatoid arthritis, and periodontitis [DHHS 2014] (Table 3-1). Smoking may also cause hearing loss in adults [Cruickshanks et al. 1998].

Inflammatory effects of tobacco smoke have been associated with many other health effects. For example, smoking has been found to delay wound healing after surgery and lead to wound complications [Sorensen 2012]. Also, tobacco smoking may increase the risk of hearing loss caused by occupational exposure to excessive noise [Tao et al. 2013]. Research on other health effects associated with exposure to tobacco smoke will undoubtedly provide a more complete understanding of the adverse health effects of smoking.

Secondhand Smoke

In the United States, SHS exposure causes more than 41,000 deaths among nonsmokers each year [DHHS 2014]. There is strong evidence of a causal relationship between SHS of adults and adverse health effects, including lung cancer, heart disease, stroke, exacerbation of asthma, nasal irritation, and (due to maternal exposure) reduced birth weight of offspring (Table 3-2) [DHHS 2006, 2014; IARC 2009; Henneberger et al. 2011]. The evidence that exposure to SHS causes health effects among exposed infants and children is also strong (Table 3-2)[DHHS 2006, 2014; IARC 2009].

There is also suggestive evidence that exposure to SHS causes a range of other health effects. These include respiratory diseases (asthma, COPD), breast cancer, and nasal cancer among nonsmoking adults, premature delivery of babies born to women exposed to SHS, and cancers (leukemia, lymphoma, brain cancer) among children exposed to SHS [DHHS 2006, 2014; IARC 2009]. SHS exposure may also be associated with hearing loss in adults [Fabry et al. 2011].

Among nonsmoking adults, health risks of SHS exposure extend to workplace exposures. A meta-analysis of 11 pertinent studies provided quantitative estimates of lung cancer risk attributable to workplace exposure to SHS; lung cancer risk was increased by 24% overall among workers exposed to SHS in the workplace, and there was a doubling of lung cancer risk among workers categorized as highly exposed to SHS in the workplace [Stayner et al. 2007]. A dramatic example of an adverse effect of exposure to SHS in the workplace was an asthmatic worker's death (see Box 3-3).

Smokeless Tobacco

Some forms of smokeless tobacco are well documented as causes of oral cancer, esophageal cancer,

Table 3-2. Health Conditions Caused by Exposure to Secondhand Smoke

Affected population	Adverse health effect
Effects on nonsmoking adults	Premature death and disease
	Lung cancer
	Coronary artery disease
	Stroke
	Asthma exacerbation
	Nasal Irritation
Effects on infants/children	Premature death and disease
	Reduced birth weight (due to maternal SHS exposure)
	Sudden infant death syndrome (SIDS)
	Slow lung growth and reduced lung function
	Lower respiratory illnesses
	More severe asthma
	Wheeze illnesses
	Respiratory symptoms (cough, phlegm, wheeze, breathlessness)
	Middle ear disease

Source: DHHS [2006, 2014]; IARC [2009]; Henneberger et al. [2011]

Box 3-3. Asthma Death and Exposure to Secondhand Smoke—A Case Report

On May 1, 2004, a 19-year-old part-time waitress, who had a history of asthma since childhood, arrived at work. She spent 15 minutes chatting with a coworker in an otherwise unoccupied room adjacent to the bar and was reported to have no apparent breathing difficulty at that time. She then entered the bar, which was occupied by dozens of patrons, many of whom were smoking. Less than 5 minutes later she reported to the manager that she wished she had her inhaler with her, needed fresh air, and needed to get to the hospital. As she walked towards the door, she collapsed. An emergency medical crew attempted resuscitation and transported her to a hospital emergency room, where she was declared dead. "Status asthmaticus" and "asphyxia secondary to acute asthma attack" were the causes of death recorded on the death certificate and autopsy report, respectively. The workplace was described by an investigator from a NIOSH-funded state program as a "typical smoky bar." Based on the nature and circumstances of the waitress's death, it was concluded by the principal investigator of the state's fatality investigation program and his colleagues that this waitress died from exposure to work-related SHS [MIFACE 2006; Stanbury et al. 2008].

and pancreatic cancer [IARC 2012], though at generally lower risk levels than those associated with smoking [DHHS 2014]. The most harmful chemicals in smokeless tobacco are tobacco-specific nitrosamines, which are formed during the growing, curing, fermenting, and aging of tobacco. Other cancer-causing substances in smokeless tobacco include polonium-210 (a radioactive element found

in tobacco fertilizer and soil) and polynuclear aromatic hydrocarbons (also known as polycyclic aromatic hydrocarbons) [DHHS 1986a]. Some newer smokeless tobacco products (e.g., snus) are processed in a way intended to substantially reduce toxicant and carcinogen content, though variable residual levels remain even in these newer products and represent potential risk to users [Stepanov et al. 2008]. All smokeless tobacco products contain nicotine, a highly addictive substance which is plausibly responsible for high risks of adverse reproductive outcomes (e.g., low birth weight, preterm delivery, and stillbirth) associated with maternal use of snus [DHHS 2014].

Electronic Nicotine Delivery Systems

Because ENDS are relatively new products that vary widely and have not been well studied, limited data are available on potential hazardous effects of active and passive exposures to their emissions [Brown and Cheng 2014; Orr 2014; Bhatnagar et al. 2014]. Questions remain regarding potential impacts of ENDS use on individual and population level health. Contrary to some marketing messages, aerosol emitted from ENDS is not merely water vapor. Many of the hazardous components identified in tobacco smoke are present in ENDS emissions, though mostly at much lower levels. Liquids formulated for ENDS use commonly contain nicotine and flavorings in a propylene glycol and/or glycerin carrier, but exact formulations of these predominant constituents and other additives and contaminants vary widely and are not well standardized [Cheng 2014]. In sum, aerosol generated by ENDS use is not as safe as clean air [CDC 2014c].

Secondhand exposure to nicotine is not without potential risk for bystanders in the vicinity ENDS use. Nicotine is addictive and is associated with various systemic toxicities at sufficient doses [NIOSH 2012] and adverse vascular effects at low doses [DHHS 2010b]. For non-smokers, nicotine is an acute irritant, capable of causing headache, nausea, and discomfort; for former smokers, nicotine exposure can trigger cravings jeopardizing their abstinence [DHHS 2014]. In pregnant women, nicotine can be transferred to and have toxic effects on the developing fetus [DHHS 2014]. In addition, other substances that have been detected or can be reasonably anticipated in aerosol produced by ENDS include known carcinogens, respiratory irritants, and other harmful and potentially harmful constituents [FDA 2009; McAuley et al. 2012; Schripp et al. 2013; Schober et al. 2013; Schaller et al. 2013; Bhatnagar et al. 2014; Cheng 2014; Goniewicz et al. 2014; Grana et al. 2014]. A recent review of the safety of ENDS use concluded that more research is warranted to determine the risk posed by various components of the liquids used in ENDS, including flavoring components in particular "because the effects of inhaling flavoring substances approved for food use are largely unknown" [Farsalinos and Polosa 2014]. Some flavorings intended for ingestion have been shown to cause serious lung disease when inhaled at high concentrations in other contexts [NIOSH 2004; CDC 2013c]. Furthermore, beyond the concerns of nonuser exposure to nicotine and these other components, there is also potential for ENDS to be used to deliver psychoactive substances such THC, the active ingredient in marijuana [Welch 2014].

A study funded by an organization that promotes consumer access to ENDS as a means of harm reduction for nicotine-addicted individuals, emphasizes that estimated exposure levels associated with the use of ENDS are generally much lower than occupational exposure limits (OELs) for toxic industrial hazards [Burstyn 2014]. However, this sort of comparison should be interpreted with caution because OELs are typically set to reduce, rather than totally prevent, adverse effects among exposed workers. Furthermore, OELs are not set to protect persons with particular vulnerabilities (e.g., asthma, cardiac or circulatory conditions, pregnancy). Finally, health-protective OELs have not been established for all chemicals capable of causing serious health impact on exposed workers [NIOSH 2004; CDC 2013c]. Thus, findings that exposures are below OELs should not lead directly to a conclusion that such exposures are entirely safe. Moreover,

another assessment concluded that current exposure guidelines for some components of ENDS emissions may in fact be exceeded during ENDS use, even for those exposed secondhand [Offerman 2014]. A recent white paper from the American Industrial Hygiene Association thoroughly reviewed the ENDS issue and cautioned that "… the existing research does not appear to warrant the conclusion that e-cigarettes are "safe" in absolute terms … e-cigarettes should be considered a source of volatile organic compounds (VOCs) and particulates in the indoor environment that have not been thoroughly characterized or evaluated for safety" [AIHA 2014].

Although much remains to be done, evaluation of ENDS exposures and short-term health effects has been a rapidly developing area of research. An experimental chamber study in which air contaminants were measured documented degradation of indoor air quality during ENDS use and found that air measurements of polycyclic aromatic hydrocarbons classified as probable carcinogens by IARC increased an average of 20% during ENDS use [Schober et al. 2013]. In light of irritant compounds (e.g., formaldehyde, acetaldehyde, and acrolein) identified in emissions from ENDS, it has been recommended that research be done to evaluate possible adverse effects of exposure to these compounds among ENDS users and individuals exposed to secondhand ENDS aerosol [Goniewicz et al. 2014]. Indeed, findings relating to short-term adverse effects on ENDS users include preliminary reports of significantly increased airways resistance [Gennimata et al. 2012] and respiratory irritation and cough, particularly among individuals with asthma [Tsikrika et al. 2014]. No studies to date have observed similar short-term effects due to secondhand exposure to ENDS aerosol, but one experimental study demonstrated that passive exposure of human volunteers to ENDS emissions did cause measurable changes in serum levels of cotinine, a metabolite of nicotine [Flouris et al. 2013].

It is plausible that personal use of ENDS and even secondhand exposure to ENDS aerosol will also lead to adverse long-term health effects, but current data are insufficient to quantify the risks [Wagener et al. 2012; BMA 2013; Kamerow 2013; AIHA 2014; Bhatnagar et al. 2014; Drummond and Upson 2014; Schraufnagel et al. 2014]. Evaluating potential long-term health effects of ENDS use is an important research priority [Andrade and Hastings 2013; AIHA 2014].

Traumatic Injuries and Fatalities Caused by Tobacco Use

Tobacco use is also an important cause of traumatic death, injury, and property damage. In 2011, there were an estimated 90,000 fires related to lighted tobacco products in the United States, resulting in an estimated 540 deaths and 1,640 injuries among civilians, and more than $600 million in property damage. Of these fires, 1 in every 4 fatalities was a victim who was not the smoker whose cigarette or other combusting tobacco product caused the fire [Hall 2013]. Annual estimates have been declining over time, in part due to the decline in smoking [Hall 2013]. In addition to injuries caused by smoking-related fires, use of tobacco products is a recognized distracting factor while operating motor vehicles [NHTSA 2009], and smoking while driving has been shown to increase the risk of being involved in a crash [Young et al. 2003]. Adverse smoking-associated physiological alterations in bone mineralization, blood vessels, and inflammatory response [Leistikow 2000a] may also contribute to higher risk of injuries, impaired recovery, and higher rates of associated disability among smokers [Lincoln et al. 2003].

Tobacco Use and Increased Risk of Work-related Disease and Injury

In the general population, personal use of tobacco and exposure to SHS both cause debilitating and fatal health problems, as outlined above. What many workers and their employers often do not fully understand is that tobacco use can increase, sometimes profoundly, the likelihood and/or the severity of occupational disease and injury caused by other hazards present in their workplaces. In addition, workplace exposure to SHS can cause serious health effects among nonsmoking workers [NIOSH

1991]. This section outlines some ways that tobacco use by workers and in the workplace can cause or worsen occupational risks (see Box 3-4). Readers are referred to other sources for more conceptual detail about how tobacco use can affect doses of hazardous industrial agents received by workers, metabolism of these agents by exposed workers, and pathogenesis and carcinogenesis of diseases caused by these agents, as well as how researchers assess complex causal relationships involving multiple causes [NIOSH 1979; DHEW 1979b; DHHS 1985; IARC 2004.

In some workplaces, an industrial toxicant released from work processes is also present in tobacco products and/or tobacco smoke. Thus, exposures to these toxicants and the risks of disease associated with them can be increased for workers who use tobacco or are exposed to SHS. These chemicals include acetone, acrolein, aldehydes (e.g., formaldehyde), arsenic, cadmium, carbon monoxide, hydrogen cyanide, hydrogen sulfide, ketones, lead, methyl nitrite, nicotine, nitrogen dioxide, phenol, and polycyclic aromatic compounds [NIOSH 1979].

Heat generated by smoking tobacco in the workplace can transform a workplace chemical to a more toxic chemical [NIOSH 1979; DHEW 1979b; DHHS 1985]. Though smokers are most highly exposed to the transformed chemical, nonsmoking coworkers in the same work area may also be exposed. Examples of occupational agents that have the potential for conversion to highly toxic chemicals by smoking tobacco products include polytetrafluoroethylene (Teflon®) and other chlorinated hydrocarbons (see Box 3-5).

Box 3-4. Some Ways Tobacco Use by Workers or in the Workplace Can Cause or Worsen Occupational Safety and Health Risks

- Tobacco smoke/tobacco products can contain the same toxic agent that is released into the workplace from a work process, thus increasing the dose of that agent received by tobacco-using workers.
- A workplace chemical can be transformed into a more harmful agent by the heat involved in smoking.
- Tobacco products can become contaminated with industrial toxicants found in the workplace, thus facilitating entry of the agent into the body through inhalation, ingestion, and/or skin absorption.
- Smoking can contribute to an effect on the body comparable to that which can result from exposure to an industrial toxicant in the workplace, thus causing an additive combined effect.
- Smoking can act synergistically with industrial toxicants found in the workplace to cause a much more profound effect than anticipated based on the known individual effects of smoking and the occupational exposure.
- Tobacco use at work can contribute to work-related traumatic injuries and fatalities, either as an ignition source for explosive or flammable agents in the workplace, or through tobacco-related distraction while operating a vehicle or machinery at work.
- Smoking at work exposes nonsmoking coworkers to the hazards of secondhand smoke.

Adapted from NIOSH [1979, 1991]

Box 3-5. Polymer Fume Fever in Smokers with Occupational Exposure to Tetrafluoroethylene

Soon after use of a new spray product containing tetrafluoroethylene (a fluorocarbon monomer) was introduced at a small industrial facility, workers began experiencing severe episodic "flu-like" symptoms. The symptoms—lower backache accompanied by fever, chills, and malaise, and a dry, nonproductive cough—occurred only on work days and usually subsided by the next morning. The spray was used in a stamp-making process, and only the employees making the stamps were affected. All the affected workers ate and smoked in their work area. After smoking was prohibited, no further symptoms occurred. Investigators concluded that workers had experienced polymer-fume fever due to contamination of cigarettes with the fluorocarbon (via the workplace air or direct contact with workers' hands) and subsequent inhalation of decomposition products created by the intense heat of the cigarettes as they smoked [CDC 1987].

Tobacco products can readily become contaminated by industrial toxicants in the workplace through contact of the tobacco products with unwashed hands or contaminated surfaces and through deposition of airborne contaminants onto the tobacco products. Subsequent use of the contaminated tobacco product, at or even away from the workplace, facilitates entry of these toxic agents into the user's body by inhalation, ingestion, and/or skin absorption [NIOSH 1979; DHEW 1979b]. To protect workers from such exposure, occupational safety and health regulations for lead, cadmium, and many other specific toxic agents prohibit use of (and even carrying of) tobacco products in designated work areas (see Appendix Table A-2 and A-3).

Often, a particular health effect can be independently caused by tobacco use and workplace exposure to a toxic agent. Thus, even if tobacco is used only away from work, users will be more severely affected than non-users, typically in an additive manner. For example, tobacco smoking reduces a worker's lung function, leaving that worker more vulnerable to the effect of any similar lowering of lung function caused by occupational exposure to dusts, gases, or fumes. Occupational exposures that, like tobacco smoking, cause chronic airways diseases and lung function impairment, include cotton dust, coal mine dust, grain dust, silica dust, welding fumes, and others [NIOSH 1979; DHEW 1979b; DHHS 1985].

For some occupational hazards, the combined impact of tobacco use and exposure to the occupational agent can be synergistic (i.e., amounting to an effect much greater than the sum of each independent effect). Adverse biological effects of smoking on the respiratory tract can lead to higher effective doses of an industrial toxicant among smoking workers compared with nonsmoking workers. For example, deposition of hazardous occupational dusts can be increased in airways narrowed by smoking, and clearance of deposited dust can be slowed by smoking-induced impairment of both alveolar and mucociliary transport [DHHS 1985]. In addition, inflammatory cells recruited to the alveoli and airways by smoking can enhance lung injury from hazardous occupational agents, and tumor promoters in tobacco smoke can act on cells initiated by an occupational carcinogen, leading to an increased likelihood that cancer will develop from the occupational exposure among smokers [DHHS 1985; IARC 2004].

An example of a synergistic effect is the combined effect of smoking and asbestos exposure on lung cancer (see Box 3-1). Smoking and asbestos exposure both independently cause lung cancer. Workers who both smoke and are exposed to asbestos at work face a much greater risk of dying from lung cancer than would be expected from the known independent risks of smoking by itself and asbestos exposure by itself [NIOSH 1979; DHEW 1979b;

IARC 2004; Frost et al. 2011; Markowitz et al. 2013]. Workers who only smoke outside of work remain vulnerable to the synergistic combined effect of smoking and asbestos exposure. Other sorts of synergistic effects may involve consideration of temporality of exposures and outcome. Workers who start smoking before they are occupationally exposed to radon may face a more-than-multiplicative risk of lung cancer that is much higher than the additive risk faced by radon-exposed workers who did not smoke until after their occupational exposure to radon [Thomas et al. 1994; IARC 2004]. With regard to temporality of outcome, radiation-induced lung cancer among radon exposed workers may occur earlier (i.e., with shorted latency) in workers who smoke than in nonsmoking workers [DHHS 1985].

When combined with certain occupational hazards, tobacco use can also enhance the risk of occupational traumatic injuries, fatalities, and property loss. First, smoking in the workplace can ignite explosive and other flammable materials. Smoking has been implicated as the known or suspected cause of several major industrial disasters in the United States, including the infamous Triangle Shirtwaist Factory fire in 1911 [Leistikow et al. 2000b]. To help prevent occupational explosions and fires, the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration (MSHA) have established a number of regulations prohibiting use and possession of smoking-related materials (e.g., cigarettes, cigars, pipes, lighters, matches) in designated hazardous work areas (see Appendix Table A-3). Despite existing regulations and widespread awareness of the risk, occupational injuries and fatalities caused by smoking have continued to occur in the United States. Though prohibited in underground coal mines, smoking materials ignited three fatal coal mine explosions between 1990 and 2000 [MSHA 2000]. OSHA records for 2000 through 2012 include documentation of 13 work-related fires or explosions—five of them fatal and all of them involving employee injuries—where smoking materials were implicated as the ignition source [OSHA 2013a] (see Box 3-6).

Tobacco use on the job can also cause occupational traumatic injuries and property loss unrelated to fires or explosions. Worker distraction by tobacco use (e.g., opening, preparing, lighting, extinguishing, or disposing of a tobacco product) or by a tobacco-caused coughing spell can result in traumatic injury or death when that worker is driving a work vehicle or operating other potentially hazardous machinery or equipment [NIOSH 1979]. Several studies have shown that smokers are more likely to be injured at work than nonsmokers [Ryan et al. 1992; Sacks and Nelson 1994; Craig et al. 2006].

As evident from the above discussion, both the type of tobacco/tobacco-related product used and where it is used can influence whether and how occupational safety and health risks are enhanced

Box 3-6. Smoking-ignited Fire Engulfs a Painting Crew—Two Dead and 11 Others Hospitalized

On July 29, 2003, two painting crews were working in a new residential subdivision when one of their two box trucks broke down near the end of the day. The company had the driver of the other truck pick up the stranded crew. That put 13 employees in the back of the truck and four in the cab. The truck was loaded with paints, lacquer thinner, stains, and acrylics, among other paint chemicals. A can of lacquer thinner spilled while employees were smoking in the truck. A lighted cigarette or a spark from a lighter ignited the lacquer thinner vapors. The truck was engulfed immediately. All 13 employees in the back of the truck were hospitalized for severe burns, and two of them died as a result of their injuries [OSHA 2013b].

by tobacco use for users and for non-users. For example, tobacco smoking in a workplace will put nonsmoking workers in that workplace at increased risk due to their workplace exposure to SHS. In contrast, in workplaces free of other occupational chemical or physical hazards, use of smokeless tobacco would not be expected to result in any increased *occupational* risk for users or their coworkers. ENDS use in the workplace could, like use of any tobacco product, plausibly enhance a user's exposure to hazardous workplace toxicants present in the workplace, may serve as a potential ignition source in workplaces where explosive atmospheres are present, and can result in secondhand exposure of coworkers (see Electronic Nicotine Delivery Systems, above).

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4 Preventive Interventions

A range of efforts has been undertaken to decrease tobacco use in the workplace and by workers. Most of these interventions focus on smoking, which is the most prevalent form of tobacco use (see Part I, above). Policies related to tobacco use in workplaces originally focused on prohibiting smoking in industrial work areas where explosion hazards were present. Currently, workplace tobacco policies increasingly center on the following:

- Smoke-free or tobacco-free indoors or campus-wide prohibitions.
- Other restrictions on tobacco use by employees.
- Tobacco vending machines removal and prohibiting other onsite sales of tobacco in workplaces.
- Provision of tobacco cessation programs.
- Employer-provided health insurance benefits designed to increase access and remove barriers to evidence-based cessation treatments and to provide incentives to quit tobacco use.
- Design of hiring policies based on smoking status.

Many preventive policies relating to smoking and the workplace are governed by local, state, or federal government laws and/or regulations. Others are independently implemented by employers as workplace requirements or conditions of employment. Employees and/or labor organizations can share in a sense of joint ownership if they meaningfully collaborate with the employer on policy language, approaches and timing, cessation supports, and compliance and consequence issues. Involving employees in the development, implementation, and evaluation of workplace programs is an effective strategy for changing employee culture and behavior [NIOSH 2008b].

Workplace tobacco policies are underpinned by several motivating interests (Boxes 4-1 and 4-2). First and foremost is an interest in protecting tobacco users' health, given that tobacco use causes

Box 4-1. Some Reasons for Employers to Implement Workplace Tobacco Interventions

- Reducing occupational disease and injuries (and workers' compensation insurance costs).
- Lowering health insurance and life insurance costs and claims.
- Decreasing costs of training workers to replace those who become disabled or die prematurely.
- Increasing productivity through reduced absenteeism and reduced presenteeism.
- Reducing accidents and fires (and related insurance costs).
- Lessening property damage (and related insurance costs).
- Eliminating indoor air pollution (and related cleaning, maintenance, and ventilation costs).
- Limiting liability and legal costs for failing to provide a safe and healthful working environment.
- Enhancing worker morale and corporate image by showing concern for employees/customers.

Adapted from DHHS [1996]

Box 4-2. Some Reasons for Employees to Quit Tobacco Use

To improve one's own health

- Reduce risk for lung, mouth, throat, and other types of cancer. For example, lung cancer risk drops by as much as 50% 10 years after quitting, and risks for cancers of the mouth and throat and bladder drop by 50% 5 years after quitting.
- Diminish risk for coronary heart disease, stroke, and peripheral vascular disease. For example, heart disease risk drops by as much as 50% 1 year after quitting. Stroke risk attributable to tobacco use may be eliminated 5 years after quitting.
- Ease symptoms such as coughing, wheezing, and shortness of breath within months of quitting and long-term risk for chronic obstructive pulmonary disease (COPD) and other respiratory diseases.
- Reduce risk of ulcer.
- Reduce risks of infertility (for women who stop smoking during their reproductive years).

To protect the health of others

- Avoid exposing family, friends, coworkers, and others to the harmful effects of secondhand smoke (SHS).
- Lessen the risk of having a low-birth-weight baby (for women who stop smoking before becoming pregnant or during the first trimester of pregnancy).
- Increase the likelihood that one's young children will not use tobacco when they reach adolescence and adulthood.

To improve personal/family finances

- Save money by not spending money on tobacco and other tobacco-related expenditures (e.g., higher insurance premiums).
- Reduce the risk of financial devastation resulting from income loss due to smoking-related disability or premature death, or from property loss due to a smoking-related home fire.

To avoid personal inconvenience

- Avoid the need to go outside, sometimes in the rain and cold, when working in a tobacco-free workplace.

the top five health conditions that impact the U.S. population [Task Force on Community Preventive Services 2010]. Protecting the health of nonsmoking workers is another important motivating interest. Although the health and safety consequences of tobacco use offer sufficient rationale for workplace tobacco policies, legal and economic considerations are also important. Government (i.e., taxpayers), employers, and employees all bear financial costs associated with adverse effects of tobacco use by workers and occupational exposure to SHS.

Legally determined employer responsibility to provide employees with a safe workplace can motivate action by employers. OSHA does not currently apply the "general duty clause" [29 USC § 654; Section 5(a)1] of the Occupational Safety and Health Act of 1970 (OSH Act), Public Law 91-596, to SHS exposure, but this is "a matter of prosecutorial discretion" [OSHA 2003]. Therefore, employers would do well not to ignore other legal implications of their duty to provide safe workplaces, including workplaces that are free from SHS exposure [Zellers et al. 2007]. Employees may bring claims under state workers' compensation laws for illness or injury attributable to SHS smoke exposure in the workplace, under federal or state disability law for failing to provide reasonable accommodations to alleviate an employee's exposure to SHS, and under the common law for failure to provide employees with a reasonably safe work environment free of SHS [Zellers et al 2007]. Adopting an effective smoke-free (or tobacco-free) workplace policy would protect an employer from such liability and provide employees with a safe workplace.

With respect to personal costs paid by individual smokers, there are obvious direct costs associated with consumer purchases of tobacco products and related materials. However, many smokers, especially those with the least discretionary income, are unaware of longer-term financial costs. One financial writer estimated in 2007 that a typical pack-a-day smoker who is spending nearly $2,000 annually just to purchase cigarettes could instead amass more than $1 million by investing that amount each year from ages 18 to 65 in an individual retirement account invested with an emphasis on growth [Karp 2007]. That estimate did not encompass costs of smoking other than the purchase price of tobacco. Smokers may be charged higher premiums for health and life insurance and generally pay more out-of-pocket costs for health care. Families can experience substantial loss of income when their smoking breadwinner becomes disabled or dies prematurely from a smoking-related disease. Financial devastation can also result from smoking-caused residential fires through costly personal injury to the smoker and/or family members and through loss of residence and other personal property. In addition, smokers and their families may incur additional costs for more frequent cleaning, repairing, or replacement of clothing and other personal furnishings to remove smoke odors and tobacco-related stains.

With respect to employers' costs, a recent study estimated excess annual cost to U.S.-based private employers associated with employees who smoke cigarettes compared with those who do not. Considering aggregate cost and productivity impacts associated with smoking breaks, absenteeism, presenteeism, healthcare expenses, and pension benefits, the study estimated that the annual cost to employ a smoker was, on average, $5,816 greater than the cost to employ a nonsmoker [Berman et al. 2013]. Interventions that help smoking workers quit can benefit a business' bottom line [NBGH 2013].

Workplace Policies Prohibiting or Restricting Smoking

For safety reasons, smoking has long been prohibited in particular work settings where explosive or extremely flammable materials are present (see Appendix Tables A-2 and A-3). A century ago, such prohibitions may have been motivated more out of concern about property loss than concern for the well-being of workers. Subsequently, concern about worker health has motivated additional policies prohibiting the use of tobacco products in specific work sites where exposure to certain hazardous occupational agents can be increased as a result of tobacco use (see Appendix Tables A-1 and A-3). The need for such venue-specific prohibitions on tobacco use has been widely understood and accepted; however, compliance with these prohibitions has been imperfect [MSHA 2000], indicating a need for ongoing training and vigilance.

In the last decades of the past century, as the public became more aware of the hazards of exposure to SHS, government (at the local, state, and federal

levels) acted with the intent to reduce workplace exposures to SHS and subsequently to eliminate SHS from workplaces [DHHS 2006]. The Surgeon General has concluded that there is no risk-free level of exposure to SHS [DHHS 2006, 2010b, 2014]. Complete prohibitions on workplace smoking have been shown to be effective in essentially eliminating SHS in workplaces [Hammond 1999]. Other measures, such as separating smokers from nonsmokers, cleaning the workplace air, and ventilating buildings, cannot eliminate exposures of nonsmokers to SHS [NIOSH 1991; DHHS 2006, 2014; ASHRAE 2013]. Thus, ventilation is not an acceptable alternative to making workplaces completely tobacco smoke-free.

Federal actions have been implemented to eliminate SHS from some workplaces. Actively supported by flight attendants and their union as a way to protect their health by eliminating SHS in their workplace, federal law has progressively prohibited smoking during commercial passenger flights, beginning in 1988 with shorter domestic flights and by 2000 encompassing all flights originating and/or terminating in the United States [Pan et al. 2005]. In 1990, the Interstate Commerce Commission acted to ban smoking on interstate buses [49 CFR Part 374.201]. A 1997 Presidential Executive Order has prohibited tobacco smoking in all interior space owned, rented, or leased by the executive branch of the federal government, with limited exceptions (e.g., specially equipped designated smoking areas, certain residential settings, and space occupied by non-federal parties)[Cook and Bero 2009]. In 2009, this policy to prohibit smoking in all interior space owned, rented, or leased by the executive branch of the federal government was extended by action of the General Services Administration, eliminating remaining indoor designated smoking areas and additionally prohibiting smoking within 25 feet of doorways and air intakes and in courtyards where those outdoor spaces are under GSA jurisdiction [73 Fed. Reg. 77517]. OSHA proposed a rule that would have more universally restricted smoking in the workplace [OSHA 1994], but later withdrew the proposed rule, noting that workplace regulation of SHS was being advanced by private employers and by state and local governments [OSHA 2001].

The first comprehensive local and state laws restricting smoking in private workplaces, restaurants, and bars went into effect in 1993 (Shasta County, California) and 2002 (Delaware), respectively [CDC 2011b, 2012]. By the end of 2010, CDC reported that 26 states, the District of Columbia, and a majority of the 50 largest U.S. cities had enacted comprehensive smoke-free laws prohibiting, with no exceptions, smoking in all indoor areas of private workplaces, restaurants, and bars [CDC 2011b, 2012]. Additionally, there has been a decline from 12/31/04 to 12/31/09 in the number of states with laws preempting the regulation by local authorities of smoking in government workplaces (from 16 to 9 states), private workplaces (from 15 to 9 states), and restaurants (from 18 to 12 states) [CDC 2010].

There is no fundamental legal impediment to adoption of smoke-free workplace policies by private employers [Graff 2008], and the private sector has taken independent actions to eliminate exposure to SHS in the workplace. In the early 1990s, new standards established by the Joint Commission on Accreditation of Hospitals spurred industry-wide adoption of workplace smoke-free policies by accredited hospitals, achieving a high level of compliance within just 2 years [Longo et al. 1995]. In addition to its intended effect on exposure to SHS, this policy has been associated with additional beneficial impacts on workplace safety and property loss (see Box 4-3). Many other businesses also voluntarily implemented smoke-free policies in their workplaces and, by the late 1990s, nearly 70% of U.S. workers employed in non-residential indoor worksites were working in smoke-free workplaces [Shopland et al. 2004].

A number of studies, including meta-analyses, have shown that smoke-free workplace policies decrease exposure of nonsmoking employees to SHS at work and increase cessation among employees who smoke [DHHS 2006; IARC 2009; Hopkins et al. 2010]. Although one review of the literature found

Box 4-3. Smoke-free Policies and Reduction in Structural Fires in Health-Care Facilities

Coinciding with comprehensive smoke-free workplace policies being enacted across the U.S. health care industry, the number of smoking-ignited structure fires involving health-care facilities dropped from well over 3,000 per year in the early 1980s to only about 100 per year since the late 1990s. Notably, the percentage of all structural fires in health-care facilities determined to have been caused by smoking materials dropped from 30% to 5% over the same period [Arhens 2010].

inconclusive evidence that smoke-free workplace policies cause smokers to quit altogether [Callinan et al. 2010], there is strong evidence that such policies are associated with increased quit rates among smoking workers and with a reduction in the amount of smoking among those workers who continue to smoke [Fichtenberg and Glantz 2002; Bauer et al. 2005; DHHS 2006; IARC 2009; Hopkins et al. 2010]. In contrast, less restrictive workplace smoking policies are associated with sustained tobacco use among workers [DHHS 2006; IARC 2009]. A nationally representative survey found that in workplaces without a workplace rule limiting smoking, workers were significantly more likely to be smokers [Ham et al. 2011].

There is clear evidence of improved health among workers as a result of policy interventions to make indoor spaces, including workplaces, smoke-free [Callinan et al. 2010]. This is especially true for workers in the hospitality industry (see Box 4-4). Smoke-free policies have been shown to improve indoor air quality, reduce SHS exposure, reduce sensory and respiratory symptoms, and improve lung function among bar workers [DHHS 2006; IARC 2009; DHHS 2014]. Implementation of smoke-free policies also has been shown in ecological studies to be associated with reduced hospitalizations for heart attacks in the general population [IARC 2009; IOM 2010; Tan and Glantz 2012; DHHS 2014]. Results of similar studies suggest that such policies may also reduce hospitalizations and emergency department visits for asthma [Hahn 2010; Mackay et al. 2010; Tan and Glantz 2012; Herman and Walsh 2011]. Smoke-free policies in

Box 4-4. Prohibiting Smoking in Bars Improves the Health of Bartenders

A state law that prohibited smoking in most California taverns and bars began on January 1, 1998. Bartenders were surveyed in the month before the law took effect and again about 1 month afterward. Self-reported exposure to SHS at work fell from a median of 28 hours per week before the law took effect to 2 hours per week afterward. Respiratory symptoms and eye, nose, and throat irritant symptoms were each reported by about 75% of bartenders before the law took effect. Of those with symptoms at baseline, 59% with respiratory symptoms and 78% with irritant symptoms experienced resolution of those symptoms after the law took effect ($P < 0.001$). On average, lung function measurements also improved. The authors of this study concluded that making taverns and bars smoke-free resulted in a rapid improvement in the health of bartenders [Eisner et al. 1998].

the hospitality industry have been found to receive high levels of public support and compliance, and they have not had a negative economic impact on the hospitality industry [DHHS 2006; IARC 2009].

Acting on strong evidence of the effectiveness of smoke-free policies available by 2001, the Task Force on Community Preventive Services recommended workplace smoking bans and restrictions as effective means for reducing exposure to SHS [Hopkins et al. 2010]. More recent evidence has led the Task Force to now recommend smoke-free workplace policies (i.e., total prohibition of smoking in the workplace), not only as a means to reduce exposure to SHS, but also as an effective means to increase tobacco cessation, reduce tobacco use prevalence, and reduce tobacco-related morbidity and mortality [Hopkins et al. 2010; Task Force on Community Preventive Services 2010; GCPS 2012a]. To prevent SHS exposures, the recent Surgeon General's report urges that comprehensive smoke-free indoor protections be extended to the entire U.S. population [DHHS 2014].

World Health Organization reports have recommended that, in the absence of evidence that can assure authorities that use of ENDS does not expose bystanders to toxic emissions, ENDS should not be exempted from laws that restrict the places in which cigarette smoking is allowed [WHO 2009, 2014]. The British Medical Association has taken the position that use of e-cigarettes should be prohibited in workplaces and public places, not only to limit potentially harmful effects of secondhand exposures, but also to ensure that their use does not undermine smoking prevention and cessation efforts [BMA 2013]. Similarly concerned about potentially hazardous secondhand exposure, the Federal German Institute for Risk Assessment has likewise recommended prohibiting use of ENDS wherever tobacco smoking is prohibited [FGIRA 2012], and the American Heart Association has recommended including e-cigarettes in smoke-free laws [Bhatnagar et al. 2014]. The Forum of International Respiratory Societies has recommended that ENDS use be prohibited "in public places, workplaces, and on public transportation" [Schraufnagel et al. 2014]. The American Industrial Hygiene Association similarly reviewed the issue of ENDS and concluded that "their use in the indoor environment should be restricted, consistent with current smoking bans, until and unless research documents that they will not significantly increase the risk of adverse health effects" to those exposed secondhand [AIHA 2014]. In the United States, the number of states and localities that explicitly prohibit use of e-cigarettes in public places where tobacco smoking is already prohibited is increasing with time [ANRF 2014], totaling 3 states and more than 200 localities before the end of 2014 [CDC 2014c].

Employers are taking notice, and some are acting to prohibit ENDS use in their workplaces [Slavit 2011; Gay 2013; Moore 2014]. Given the current unregulated nature of ENDS and the liquid concoctions used them, along with uncertainty about the impact of ENDS use in the workplace on the health of non-users, the simplest approach is for employers to simply add ENDS to the list of products covered by their tobacco-free (or smoke-free) workplace policy [Phillips 2014].

Employer Prohibitions on Tobacco Use Extending Beyond the Workplace

Some employers have taken action to extend restrictions on tobacco use by their employees beyond the workplace. For example, in 2013, the U.S. Public Health Service Commissioned Corps became the first federal uniformed service to prohibit tobacco use by its officers whenever and wherever they are in uniform [ACPM 2013]. More controversial are attempts of private employers to control the behavior of their employees outside of the workplace. For example, at a major medical center that had a smoke-free campus policy in place for years, the employer recently announced plans to prohibit smoking by workers during their workday breaks, including lunchtime, even when off campus [Toland 2013]. Several large employers and organizations (including the Cleveland Clinic, Union

Pacific Railroad, the World Health Organization, and several others) have gone further by barring the hiring of smokers [Asch et al. 2013; Schmidt et al. 2013].

Controversy surrounds many organizational policies that bar the hiring of smokers or prohibit tobacco use by employees during the workday when they are away from the worksite even on their own time. Proponents argue that a nonsmoking workforce serves as a positive role model for health, experiences better health status, incurs substantially lower health-care costs for employers and employees alike, and improves productivity [Asch et al. 2013]. Opponents posit the addictive nature of tobacco and the fact that tobacco use usually begins in adolescence, note that tobacco use remains legal, and cite the disparate and potentially discriminatory effects such a policy might have on minority, lower-income, or less educated workers and job candidates—groups that tend to have higher levels of tobacco use. They also point out that employers who refuse to hire smokers typically do not similarly refuse to hire individuals with other personal health behaviors that, like tobacco use, have adverse health consequences. They add that more than half of states have laws in place prohibiting employers from refusing to hire individuals because they smoke [Schmidt et al. 2013].

Workplace Tobacco Use Cessation Programs

Smoking employees who want to quit can benefit from employer-provided resources and assistance. In 2010, roughly 65% of employed smokers in the United States expressed an interest in quitting tobacco and about half reported having tried to quit in the previous year [Yong et al. 2014]. Just as policies increasing tobacco taxes at the state and federal levels have led to increased calls to state telephone tobacco cessation quitlines [McGoldrick and Boonn 2010], implementing tobacco-free workplace policies can be expected to increase worker interest in quitting and cessation support services. When a smoking cessation program is established in a workplace, smokers employed at that workplace are more likely to intend to quit in the next 6 months [Ham et al. 2011]. Various levels and types of cessation support can be provided [DHHS 1996].

On a basic level, a health-care provider's inquiry about tobacco use and delivery of brief counseling advice to tobacco users has been shown to increase quit rates, with more intensive intervention having a greater effect [O'Hara et al. 1993; Clinical Practice Guideline 2008]. This basic approach can be readily 'piggy-backed' on occupational health services that already exist in many workplaces. For example, all workers enrolled in OSHA-mandated respiratory protection programs must be asked about tobacco use as part of their medical evaluation (see Appendix Table A-2 for applicable OSHA standard numbers). Other existing opportunities to ascertain individual smoking behavior include post-employment (pre-placement) examinations, fitness-for-duty evaluations, and other health examinations already provided by employers. Whenever workers who smoke are identified, they can be counseled and offered cessation assistance.

Occupational health providers and workplace health promotion staff can offer basic cessation assistance by encouraging workers to use tobacco cessation telephone quitlines, web-based cessation services, and cessation text-messaging programs, such as those offered by the National Cancer Institute through http://smokefree.gov/smokefreetxt. State quitlines exist in all 50 states and the District of Columbia, are publicly funded, are typically available at no cost to smokers, and often provide free or discounted FDA-approved cessation medications. Callers can access their state quitline by dialing 1-800-QUIT-NOW (1-800-784-8669). Similarly, Spanish-speaking callers can access Spanish-language services from their state quitline by calling 1-855-DEJELO-YA (1-855-335-3569). Because of strong evidence that quitlines increase quit rates, the 2008 Public Health Service Clinical Practice Guideline and the Community Preventive Services Task Force recommend quitline interventions, especially proactive quitlines where the counselor initiates follow-up calls [GCPS 2012b; Clinical

Practice Guideline 2008]. The Public Health Service Guideline further concludes that quitlines are effective with diverse populations and have broad reach [Clinical Practice Guideline 2008]. Similarly, the Community Preventive Services Task Force found that quitlines—especially proactive quitlines where the counselor initiates follow-up calls—increase tobacco cessation among callers who are interested in quitting and can help expand the use of evidence-based cessation services among smokers in populations that have limited access to cessation treatment [GCPS 2012b]. An updated Cochrane review has reaffirmed the effectiveness of proactive quitlines [Stead et al. 2013]. Their widespread availability, ease of accessibility, affordability, and potential reach to populations with higher levels of tobacco use make quitlines an important component of any cessation effort [Clinical Practice Guideline 2008]. Yet many employers do not make their employees aware of them. For example, a 2008 Washington State survey of almost 700 employers with at least 50 employees found that only 6% mentioned the availability of the state quitline in their health promotion messages to workers [Hughes et al. 2011].

The most comprehensive workplace cessation programs go well beyond minimal cessation counseling and referral to no-cost quitlines and web-based programs. Employers can enter into preferred relationships with state quitlines or contract quitline providers to establish employer-specific quitlines with special services [Lichtenstein et al. 2010]. Web-based intervention to assist with tobacco cessation is a less studied but promising approach [Clinical Practice Guideline 2008; Civljak et al. 2013]. One report described success achieved by a major corporation with a program offering employees web-based cessation intervention [Graham et al. 2007]. Individualized counseling and support can often be provided by an existing employee assistance program. A systematic review of the literature found that workplace-based smoking cessation services such as individual and group counseling, pharmacological treatment, and social support are all effective in enhancing quit rates when compared with no interventions or minimal interventions [Cahill and Lancaster 2014]. Optimal work-based tobacco cessation programs are designed to provide follow-up assistance and to support multiple quit attempts, because most smokers try to quit repeatedly before finally succeeding [Clinical Practice Guideline 2008].

Ideally, employers should incorporate tobacco cessation support programs into a more comprehensive approach that addresses the overall safety, health, and well-being of workers. A growing evidence base supports the enhanced effectiveness of workplace programs that integrate health promotion efforts such as smoking cessation with more specific occupational health protection programs [Hymel et al. 2011; NIOSH 2013b]. Such integrated workplace tobacco cessation programs may be most usefully implemented among blue-collar workers, who generally have higher smoking (and lower quitting) rates than office workers and who generally face higher risks from industrial hazards. A large randomized study involving 15 manufacturing sites showed that combining occupational health and safety messages with health promotion messages resulted in a doubling of smoking quit rates among hourly workers (from 5.9% to 11.8%; $P = 0.04$) compared with health promotion messages alone [Sorensen et al. 2003]. Another demonstration study of an integrated program aimed at enhancing smoking cessation among blue collar workers targeted participants in a union apprenticeship program [Barbeau et al. 2006] (see Box 4-5).

Health Insurance and Smoking Behavior

Another recent phenomenon is the increasing use of health insurance to encourage employees to adopt positive personal health-related behaviors (e.g., smoking cessation) through modification in the design of benefits and out-of-pocket cost for covered individuals. For example, it is known that quit rates are higher when health insurance covers the costs of evidence-based smoking cessation treatments [Clinical Practice Guideline 2008].

Box 4-5. Demonstration of a Smoking Cessation Program for Blue-Collar Workers

Apprentice ironworkers at a local union in Boston were studied before and after a 4-month smoking cessation demonstration program. With input from union leaders and members, the program was carried out in a local union hall, where posters promoting cessation and featuring photographs of ironworkers were displayed. Articles explaining and promoting the program were published in the union newsletter. Occupational health protection aspects of the program were featured in an educational module on "toxics and tobacco." This module was taught by an industrial hygienist and covered separate and combined adverse health effects, including cancer, caused by smoking and workplace hazards (e.g., asbestos, welding fumes, and diesel exhaust) commonly encountered by ironworkers. Tobacco treatment specialists led weekly group sessions on tobacco cessation. Incentives to participate in the sessions included free lunches and, for those attending all sessions, a chance for a raffle prize. Self-help quit kits were provided to apprentices who chose not to attend the group sessions. Nicotine replacement therapy was available at no cost to participants. Of 337 participants, 139 (41.2%) were current smokers at the time the program started. One month after the program concluded, 27 (19.4%) of those smokers had quit—a rate much higher than the expected ~5% quit rate. Program participants were 3 times more likely to quit than nonparticipants [Barbeau et al. 2006].

Ideally, such coverage should provide access to all evidence-based cessation treatments, including individual, group, telephone counseling, and all seven FDA-approved cessation medications [Clinical Practice Guideline 2008; CDC 2014c]. This coverage should have minimal barriers (such as cost-sharing and prior authorization) or no barriers [Clinical Practice Guideline 2008; CDC 2014b]. The coverage should also be promoted to tobacco users and health-care providers to ensure that they are aware of it and to that the covered treatments are used [Clinical Practice Guideline 2008; CDC 2014b].

Many workers are covered by employer-provided health insurance, and the employer can negotiate with the insurance company to set benefits, premiums, and cost shares for covered workers. For multi-employer health insurance programs that cover millions of union workers, representatives of the union also have a voice in the process. Insurance companies and human resources managers responsible for designing and negotiating health insurance plans need to be aware of various laws at the state and federal levels that limit what can be negotiated. Applicable federal laws include the Health Insurance Portability and Accountability Act (HIPAA), Public Law 104-191, and the Patient Protection and Affordable Care Act (ACA), Public Law 111-148, which is now being implemented [Madison et al. 2013].

The ACA includes provisions pertinent to tobacco use and cessation [McAfee et al. 2015]. For the many workers covered by group and individual private health insurance plans, including both fully insured and self-insured employer coverage, the ACA requires non-grandfathered private plans to cover—without cost sharing—all preventive services judged by the U.S. Preventive Services Task Force to provide a high certainty of substantial (grade A) or a moderate-to-substantial (grade B) net benefit. This includes tobacco use counseling and tobacco cessation interventions, to which the

Task Force assigned an "A" grade [Kofman et al. 2012]. Federal guidance clarifying this requirement states that health plans will be considered to be in compliance with this requirement if, for example, they cover (1) screening for tobacco use; (2) at least two quit attempts a year, with each quit attempt including four sessions of individual, group, and telephone counseling of at least ten minutes each and all seven FDA-approved cessation medications for a 90-day course [USDOL 2014 McAfee et al. 2015]. The guidance further states that none of these treatments should be subject to cost-sharing or prior authorization [USDOL 2014; McAfee et al. 2015]. If fully implemented by health insurers, this level of coverage, which is closely based on the 2008 U.S. Public Health Service Clinical Practice Guideline, would be expected to increase smokers' access to proven cessation treatments and to help thousands of smokers quit [McAfee et al. 2015].

Insurers and employers who sponsor health insurance coverage for their employees will have expanded opportunities to design incentives for wellness programs, including interventions intended to enhance tobacco cessation (or, with some limitations, disincentives for continued tobacco use). For example, in order to motivate employees to quit smoking, the ACA allows employer-sponsored health insurance issuers to charge tobacco users premiums that are up to 50% higher than premiums charged non-tobacco users [Kofman et al. 2012; Madison et al. 2013]. However, issuers who impose these surcharges in the small-group market must provide tobacco users the opportunity to avoid them, for example by participating in a cessation program [78 Fed. Reg. 33158]. States have authority to limit the magnitude of such surcharges, and a number of states have done so [CMS 2014].

Using Incentives and Disincentives to Modify Tobacco Use Behavior

Increasingly, governmental and employer actions are removing barriers and offering incentives for employee quit attempts and success in quitting tobacco use. Likewise, such actions are increasingly discouraging tobacco use by workers covered by employer-sponsored health insurance programs (e.g., through increased premiums for smokers). For example, more than one-third of surveyed large employers who offer their employees smoking cessation programs incentivize participation in these programs. The number of large employers who are planning to reward or penalize smokers based on their smoking status is increasing—more than half of companies plan to do so by the end of 2013, up from less than 25% of employers who did so in 2010 [Towers Watson 2011].

A clear barrier that reduces use of evidence-based cessation treatments is out-of-pocket costs for cessation counseling and FDA-approved cessation medications. Because of strong evidence that the number of tobacco users who quit can be increased by reducing these out-of-pocket costs, the Community Preventive Services Task Force recommends reducing tobacco users' out-of-pocket costs for cessation treatments [GCPS 2012c].

The Task Force had earlier examined the issue of providing incentives for tobacco cessation, finding insufficient evidence at that time that workplace-based incentives or competitions by themselves reduced tobacco use among employees [GCPS 2005]. Even then, the Task Force went on to recommend worksite-based incentives and competitions when they are combined with other evidence-based interventions (e.g., education, group support, telephonic counseling, self-help materials, smoke-free workplace policies) as part of a comprehensive cessation program [GCPS 2005].

A subsequent systematic review of the literature identified a single well-designed study in which financial incentives integrated into a smoking cessation program produced a substantial and sustained beneficial impact [Cahill and Perera 2011]. Incentive payments for that randomized trial were structured as $100 for completion of the smoking-cessation program; $250 for abstinence (confirmed biochemically) during the first 6 months after study

enrollment; and $400 for abstinence (also confirmed biochemically) during the subsequent 6 months. Smokers offered the financial incentives were three times as likely to enroll in the program (15.4% vs. 5.4%, $P < 0.001$), four times as likely to complete the program (10.8% vs. 2.5%, $P < 0.001$), and three times as likely to remain abstinent more than a year later (14.7% vs. 5.0%, $P < 0.001$) [Volpp et al. 2009]. Notably, this study did not involve establishing a new smoking cessation program; rather, all participants were informed about existing smoking-cessation resources available in their community and about employer-provided health benefits related to smoking cessation.

A recent review explored ethical and legal issues relating to employer-provided incentives intended to change individual health behaviors, including tobacco use [Madison et al. 2011]. The authors identified a number of specific issues that call for scrutiny, including the need to ensure that incentive programs are designed to work as intended, and the potential for incentives to be used in an unduly coercive or discriminatory manner. They emphasized that employers should play a collaborative, supportive role in advancing the health of workers, and they further suggested that, in order to limit the potential for discrimination, programs should be designed to minimize differences in individual employees' abilities to access incentives [Madison et al. 2011]. It should be recognized that, while imposing insurance premium surcharges or other disincentives on smokers has the potential to motivate them to quit smoking, the evidence that they are effective in doing so is quite limited, and care is needed to avoid such practices having unintended consequences. For example, these practices could lead smokers to conceal their smoking (and thereby not benefit from cessation assistance), or even to forgo health insurance coverage or quit their jobs [Madison et al. 2011; McAfee et al. 2015]. The appropriate intent of incentives is to improve health and reduce health-care costs overall, and not merely to shift health-care costs to high-risk individuals [Madison et al. 2011, 2013].

In summary, workplace policies are powerful tools that can benefit worker health. Well-designed policies protect workers from occupational risks, provide workplace-associated opportunities for enhancing worker health, and motivate workers to take beneficial actions to protect their well-being. Although not a primary focus of this CIB, workplace policies that effectively sustain or improve worker health can also be cost-effective and benefit the employer's bottom line.

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5 Conclusions

- Cigarette smoking by workers and SHS exposure in the workplace have both declined substantially over recent decades, but about 20% of all U.S. workers still smoke and about 20% of nonsmoking workers are still exposed to SHS at work.
- Smoking prevalence among workers varies widely by industry and occupation, approaching or exceeding 30% in construction, mining, and accommodation and food services workers.
- Prevalence of ENDS use by occupation and industry has not been studied, but ENDS has grown greatly, with about 1 in 3 current U.S. adult smokers reporting ever having used e-cigarettes by 2013.
- Smokeless tobacco is used by about 3% of U.S. workers overall, but smokeless tobacco is used by more than 10% workers in construction and extraction jobs and by nearly 20% of workers in the mining industry, which can be expected to result in disparities in tobacco-related morbidity and mortality.
- Tobacco use causes debilitating and fatal diseases, including cancer, respiratory diseases, and cardiovascular diseases. These diseases afflict mainly users, but they also occur in those exposed to SHS. Smoking is substantially more hazardous, but use of smokeless tobacco also causes adverse health effects. More than 16 million U.S. adults live with a disease caused by smoking, and each year nearly a half million die prematurely from smoking or exposure to SHS.
- Tobacco use is associated with increased risk of injury and property loss due to fire, explosion, and vehicular collisions.
- Tobacco use by workers can increase, sometimes profoundly, the likelihood and the severity of occupational disease and injury caused by other workplace hazards (e.g., lead, asbestos, and flammable materials).
- Restrictions on smoking and tobacco use in specific work areas where particular high-risk occupational hazards are present (e.g., explosives, highly flammable materials, or highly toxic materials that could be ingested via tobacco use) have long been used to protect workers.
- A risk-free level of exposure to SHS has not been established, and ventilation is insufficient to eliminate indoor exposure to SHS.
- The risk of adverse health effects associated with using ENDS or secondhand exposure to particulate aerosols and gases emitted from ENDS remains to be fully characterized.
- Policies that prohibit tobacco smoking throughout the workplace (i.e., smoke-free workplace policies) are now widely implemented, but they have not yet been universally adopted across the United States. These policies improve workplace air quality, reduce SHS exposure and related health effects among nonsmoking employees, increase the likelihood that workers who smoke will quit, decrease the amount of smoking during the working day by employees who continue to smoke, and have an overall impact of improving the health of workers (i.e., among both nonsmokers who are no longer exposed to SHS on the job and smokers who quit).
- Workplace-based efforts to help workers quit tobacco use can be easily integrated into existing occupational health and wellness programs. Even minimal counseling and/or simple referral to state quitlines, mobile phone texting interventions, and web-based intervention can be effective, and more comprehensive programs are even more effective.
- Integrating both occupational safety and health protection components into workplace health promotion programs (e.g., smoking

cessation) can increase participation in tobacco cessation programs and successful cessation among blue-collar workers.

- Smokers, on average, are substantially more costly to employ than nonsmokers.
- Some employers have policies that prohibit employees from using tobacco when away from work or that bar the hiring of smokers or tobacco users. However, the ethics of these policies remain under debate, and they may be legally prohibited in some jurisdictions.

6 Recommendations

The following recommendations relate specifically to the issues raised in this CIB. NIOSH recommends that employers take the following actions related to employee tobacco use:

- At a minimum, establish and maintain smoke-free workplaces that protect those in workplaces from involuntary, secondhand exposures to tobacco smoke and airborne emissions from e-cigarettes and other electronic nicotine delivery systems. Ideally, smoke-free workplaces should be established in concert with tobacco cessation support programs. Smoke-free zones should encompass (1) all indoor areas without exceptions (i.e., no indoor smoking areas of any kind, even if separately enclosed and/or ventilated), (2) all areas immediately outside building entrances and air intakes, and (3) all work vehicles. Additionally, ashtrays should be removed from these areas.
- Optimally, establish and maintain entirely tobacco-free workplaces, allowing no use of any tobacco products across the entire workplace campus (see model policy in Box 6-1).
- Comply with current OSHA and MSHA regulations that prohibit or limit smoking, smoking materials, and/or use of other tobacco products in work areas characterized by the presence of explosive or highly flammable materials or potential exposure to toxic materials (see Table A-3 in the Appendix). To the extent feasible, follow all similar NIOSH recommendations (see Table A-2 in the Appendix).
- Provide information on tobacco-related health risks and on benefits of quitting to all employees and other workers at the worksite (e.g., contractors and volunteers).
  - Inform all workers about health risks of tobacco use.
  - Inform all workers about health risks of exposure to SHS.
  - Train workers who are exposed or potentially exposed to occupational hazards at work about increased health and/or injury risks of combining tobacco use with exposure to workplace hazards, about what the employer is doing to limit the risks, and about what the worker can do to limit his/her risks.
- Provide information on employer-provided and publicly available tobacco cessation services to all employees and other workers at the worksite (e.g., contractors and volunteers).
  - At a minimum, include information on available quitlines, mobile phone texting interventions, and web-based cessation programs, self-help materials, and employer-provided cessation programs and tobacco-related health insurance benefits available to the worker.
  - Ask about personal tobacco use as part of all occupational health and wellness program interactions with individual workers and promptly provide encouragement to quit and guidance on tobacco cessation to each worker identified as a tobacco user and to any other worker who requests tobacco cessation guidance.
- Offer and promote comprehensive tobacco cessation support to all tobacco-using workers and, where feasible, to their dependents.
  - Provide employer-sponsored cessation programs at no cost or subsidize

cessation programs for lower-wage workers to enhance the likelihood of their participation. If health insurance is provided for employees, the health plan should provide comprehensive cessation coverage, including all evidence-based cessation treatments, unimpeded by co-pays and other financial or administrative barriers.

— Include occupational health protection content specific to the individual workplace in employer-sponsored tobacco cessation programs offered to workers with jobs involving potential exposure to other occupational hazards.

- Become familiar with available guidance (e.g., CDC's "Implementing a Tobacco-Free Campus Initiative in Your Workplace") (see Box 6-2) and federal guidance on tobacco cessation insurance coverage under the ACA (e.g., http://www.dol.gov/ebsa/faqs/faq-aca19.html) before developing, implementing, or modifying tobacco-related policies, interventions, or controls.

- Develop, implement, and modify tobacco-related policies, interventions, and controls in a stepwise and participatory manner. Get input from employees, labor representatives, line management, occupational safety/health and wellness staff, and human resources professionals. Those providing input should include current and former tobacco users, as well as those who have never used tobacco. Seek voluntary input from employees with health conditions, such as heart disease and asthma, exacerbated by exposure to SHS.

- Make sure that any differential employment benefits policies that are based on tobacco use or participation in tobacco cessation programs are designed with a primary intent to improve worker health and comply with all applicable federal, state, and local laws and regulations. Even when permissible by law, these differential employment benefit policies—as well as differential hiring policies based on tobacco use—should be implemented only after seriously considering ethical concerns and possible unintended consequences. These consequences can include the potential for adverse impacts on individual employees (e.g., coercion, discrimination, and breach of privacy) and the workforce as a whole. Furthermore, the impact of any differential policies that are introduced should be monitored to determine whether they improve health and/or have unintended consequences.

NIOSH recommends that workers who smoke cigarettes or use other tobacco products take the following actions:

- Comply with all workplace tobacco policies.
- Ask about available employer-provided tobacco cessation programs and cessation-related health insurance benefits.
- Quit using tobacco products. Know that quitting tobacco use is beneficial at any age, but the earlier one quits, the greater the benefits. Many people find various types of assistance to be very helpful in quitting, and evidence-based cessation treatments have been found to increase smokers' chances of quitting successfully. Workers can get help from

  — tobacco cessation programs, including web-based programs (e.g., http://smokefree.gov and http://www.cdc.gov/tips) and mobile phone texting services (e.g., the SmokefreeTXT program http://smokefree.gov/smokefreetxt);

  — state quitlines (phone: 1-800-QUIT-NOW [1-800-784-8669], or 1-855-DEJELO-YA [1-855-335-3569 for Spanish-speaking callers]); and/or

  — health-care providers.

In addition, individual workers who want to quit tobacco may find several of the websites listed in Box 6-2 helpful.

NIOSH recommends that all workers, including workers who use tobacco and nonsmokers exposed to SHS at their workplace:

- Know the occupational safety and health risks associated with their work, including those that can be made worse by personal tobacco use, and how to limit those risks; and
- Consider sharing a copy of this CIB with their employer.

Box 6-1: A Model Policy for a Tobacco-Free Workplace

[COMPANY]'s TOBACCO-FREE POLICY

I. PURPOSE

[COMPANY] is dedicated to providing a healthy, comfortable, and productive work environment for all of our employees and clients. The goal of this policy is two-fold. First, this policy aims to promote a safe work environment for everyone who works on or visits [COMPANY]'s campus. Second, this policy is designed to improve the health of [COMPANY]'s employees by promoting tobacco use cessation.

II. POLICY

Effective [DATE], [COMPANY] is implementing a campus-wide tobacco-free policy that applies to all employees, clients, and visitors. This policy prohibits the use of any tobacco products, including but not limited to smokeless tobacco, cigarettes, cigars, and electronic smoking/vaping devices. This policy is in effect at all times, including during and after regular business hours. Smoking or use of tobacco products will not be permitted in any indoor or outdoor space owned, leased, or used by the company or within 25 feet of any door, window, or ventilation system. Additionally, tobacco use will not be permitted in company-owned parking lots or vehicles. This policy also applies to any work function where two or more employees are present, regardless of where the event is held.

Employees who choose to use tobacco products may do so during their regularly scheduled breaks off company property. Ashtrays will not be provided or permitted in any company area. Smoking areas may be designated at the discretion of management. Any designated smoking areas must be accompanied by proper signage, and they must be located at least 25 feet away from any door, window, or ventilation system.

This policy also prohibits the sale on company property of any tobacco products, including but not limited to cigarettes, cigars, pipe tobacco, smokeless tobacco, and electronic smoking/vaping devices and materials.

III. PROCEDURE

Copies of this policy shall be distributed to all current employees in advance of the implementation date. All future employees will be provided a copy of this policy during the hiring process and a copy will be available for review from [COMPANY]'s human resources department at any time. Signs stating that this is a "Tobacco-Free Campus" will be posted.

Compliance with this policy is mandatory and violations will be subject to disciplinary action in accordance with other relevant company policy. Repeated violations may result in more serious disciplinary action, to be handled by supervisors in conjunction with the human resources department. [COMPANY] will not retaliate, discourage, or prohibit any employee, client or visitor from reporting violations of this policy.

Box 6-1: A Model Policy for a Tobacco-Free Workplace (Continued)

IV. TOBACCO CESSATION OPPORTUNITIES

[COMPANY] encourages all employees who currently use tobacco products to quit by taking advantage of cessation programs available through the company. More information about these offerings can be obtained by contacting [APPROPRIATE WORKPLACE CONTACT] or human resources.

V. QUESTIONS

Any questions regarding this policy should be directed to [NAME OF APPROPRIATE WORKPLACE CONTACT] at [NUMBER].

Thank you for your cooperation.

Adapted from CDC [2005], ANR [2014], and the University of Maryland Francis King Carey School of Law Legal Resource Center [2014].

Box 6-2. Selected Web Resources

Government

U.S. Department of Health And Human Services

- **Smokefree.gov**
  http://www.Smokefree.gov
- **BeTobaccoFree.gov**
  http://betobaccofree.hhs.gov/index.html
- **The Guide to Community Preventive Services: Reducing Tobacco Use and Secondhand Smoke Exposure**
  http://www.thecommunityguide.org/tobacco/index.html

CDC

- **Office on Smoking and Health**
  http://www.cdc.gov/tobacco/quit_smoking/index.htm
- **Tobacco Use Cessation**
  http://www.cdc.gov/workplacehealthpromotion/implementation/topics/tobacco-use.html

Box 6-2. Selected Web Resources (Continued)

CDC (Continued)

- **Tips from Former Smokers**
  http://www.cdc.gov/tips/
- **Implementing a Tobacco-Free Campus Initiative in Your Workplace**
  http://www.cdc.gov/nccdphp/dnpao/hwi/toolkits/tobacco/index.htm
- **"Save Lives, Save Money: Make Your Business Smoke-Free"**
  http://www.cdc.gov/tobacco/basic_information/secondhand_smoke/guides/business/pdfs/save_lives_save_money.pdf
- **A Practical Guide to Working with Health-Care Systems on Tobacco-Use Treatment**
  http://www.cdc.gov/tobacco/quit_smoking/cessation/practical_guide/pdfs/practical_guide.pdf
- **Total Worker Health™**
  http://www.cdc.gov/niosh/twh/
  http://www.cdc.gov/niosh/twh/essentials.html
- **Tobacco Smoke in the Workplace**
  http://www.cdc.gov/niosh/topics/tobacco/

Other

North American Quitline Consortium (NAQC)

- **Quitline Map**
  http://map.naquitline.org/

American Lung Association

- **Stop Smoking**
  http://www.lung.org/stop-smoking/
- **Workplace Wellness**
  http://www.lung.org/stop-smoking/workplace-wellness/

American Cancer Society

- **Great American Smokeout**
  http://www.cancer.org/healthy/stayawayfromtobacco/greatamericansmokeout/index
- **"Strategies for Promoting a Smoke-free Workplace Policy"**
  http://www.cancer.org/downloads/gahc/hp_strategies_for_promoting_and_implementing_smokefree_workplace.pdf
- **Making Your Workplace Smokefree: A Decision Maker's Guide**
  http://www.cancer.org/acs/groups/content/@highplains/documents/document/makingyour-workplacesmokefreegu.pdf

Box 6-2. Selected Web Resources (Continued)

American Heart Association

- **Quit Smoking**
  http://www.heart.org/HEARTORG/GettingHealthy/QuitSmoking/Quit-Smoking_UCM_001085_SubHomePage.jsp

American Legacy Foundation

- **EX: A New Way to Think About Quitting Smoking**
  http://www.becomeanex.org

National Business Group on Health

- **Tobacco: The Business of Quitting—An Employer's Website for Tobacco Cessation**
  http://www.businessgrouphealth.org/tobacco/benefits

PACT (Professional Assisted Cessation Therapy)

- **Employers' Tobacco Cessation Guide: Practical Approaches to a Costly Workplace Problem**
  http://www.elginhealth.on.ca/downloads/RIYSEQXL.pdf

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APPENDIX

Table A-1. Previous NIOSH Current Intelligence Bulletins on Tobacco Use

Publication (year)	Findings	Recommendations
Current Intelligence Bulletin 31 Smoking and the Occupational Environment (1979)	Smoking and/or tobacco products defined as cigarettes, cigars, pipe tobacco, chewing tobacco, and any by-products resulting from their burning and/or use. Identified six ways smoking and/or other tobacco use can interact with workplace exposures to worsen occupational disease and injury: 1. Certain toxic agents present in some workplaces may also be present in tobacco smoke, increasing exposure to those agents. 2. Some workplace chemicals can be transformed into more harmful agents by smoking—specifically by the heat generated by burning tobacco. 3. Tobacco products can become contaminated with toxic agents present in the workplace, thus facilitating entry of the agent into the body by inhalation, ingestion, and/or skin absorption. 4. Smoking can cause adverse health effects comparable to those caused by exposure to toxic agents present in some workplaces, thus causing additive effects. 5. Smoking can act synergistically with toxic agents present in some workplaces to cause a much more profound effect than anticipated simply from the separate influences of the occupational exposure and smoking. 6. Smoking can contribute to accidents in the workplace.	Use of and/or carrying of tobacco products into the workplace should be curtailed in situations where employees may be exposed to physical or chemical substances that may interact with tobacco products. Curtailment of the use of tobacco products in the workplace should be accompanied by simultaneous control of worker exposure to hazardous physical and chemical agents.

See footnotes at end of table.

(Continued)

Table A-1. Previous NIOSH Current Intelligence Bulletins on Tobacco Use (Continued)

Publication (year)	Findings	Recommendations
Current Intelligence Bulletin 54 Environmental Tobacco Smoke in the Workplace: Lung Cancer and Other Effects* (1991)	Main conclusion: "NIOSH has determined that the collective weight of evidence … is sufficient to conclude that [*SHS*]* poses an increased risk of lung cancer and possibly heart disease to occupationally exposed workers." Conclusions and recommendations based on: • Reports of Surgeon General on health effects of tobacco smoke. • Comparison of chemical compositions of SHS and mainstream smoke. • Results from recent epidemiologic studies of nonsmokers exposed to SHS. • Methods for controlling involuntary workplace exposures to ETS.*	Risk of developing cancer should be decreased by minimizing exposure to SHS. Workers should not be involuntarily exposed to tobacco smoke. Employers should … assess conditions that may result in worker exposure to SHS and take steps to reduce exposures to the lowest feasible concentration. Best method for controlling worker exposure to SHS is to eliminate tobacco use from the workplace and begin a smoking cessation program. Management and labor should work together to develop nonsmoking policies: • Prohibit smoking at the workplace; post signs at workplace entrances. • Distribute information about health promotion and harmful effects of smoking. • Offer smoking-cessation classes to all workers. • Establish incentives to encourage workers to stop smoking. Pending complete elimination of tobacco smoking in the workplace, smoking should be isolated to clearly posted, enclosed areas, with separate ventilation exhausted directly to the outside without recirculation.

*The 1991 document used the term "environmental tobacco smoke" (ETS) to refer to what this CIB calls "secondhand smoke" (SHS).

Table A-2. Other NIOSH Publications with Policy Recommendations Relating to Tobacco Use

Year	Agent/Process	Tobacco-related Recommendation(s)	Selected Additional Content
		Criteria Documents	
1972	Asbestos	Smoking cessation (as medical management for exposed workers who smoke).	
1972	Carbon monoxide	Medical exams, which could provide "opportunity to conduct anti-smoking programs for high-risk employees."	
1973	Inorganic mercury	No smoking in designated areas; wash before smoking.*	
1975	Inorganic fluorides	No smoking in designated areas; wash before smoking/chewing*; no carrying tobacco products in contaminated clothing.	
1976	Boron trifluoride	No smoking or uncovered smoking materials in designated areas.	
1976	Cadmium	No smoking or carrying uncovered tobacco products in designated areas.	
1976	Carbaryl	No smoking in designated areas; wash before smoking.*	
1976	Formaldehyde	No smoking in designated areas; wash before smoking.*	
1976	Methyl parathion	No smoking or carrying tobacco products in designated areas; wash before smoking*; post "No smoking" signs; provide area free of contamination for storing tobacco products.	
1976	Organotin compounds	No smoking in designated areas.	
1976	Parathion	No smoking or carrying tobacco products in designated areas; wash before smoking*; post "No smoking" signs; provide area free of contamination for storing tobacco products.	

See footnotes at end of table.

(Continued)

Table A-2 (Continued). Other NIOSH Publications with Policy Recommendations Relating to Tobacco Use

Year	Agent/Process	Tobacco-related Recommendation(s)	Selected Additional Content
1978	Dinitro-ortho-cresol	No smoking in designated areas.	
1976	Carbon tetrachloride	No smoking in designated areas; wash before smoking.*	
1979	Chloroform	No smoking in designated areas; wash before smoking.*	
1988	Welding, brazing, and thermal cutting	No use or storage of tobacco products in designated areas; wash before smoking*; counsel smokers about how smoking may enhance adverse effects of occupational hazards.	
2006	Refractory ceramic fibers	No smoking in workplace; collect smoking histories as part of the medical monitoring program; counsel workers who smoke tobacco products about increased risk of adverse respiratory effects induced by RCF; disseminate information about health promotion and the harmful effects of smoking; establish and offer smoking cessation programs to workers at no cost; all workers who smoke and are potentially exposed to RCFs should participate in smoking cessation program.	Entire sections (1.13and 9.6) devoted to smoking cessation. NIOSH recognizes a synergistic effect of smoking and exposure to RCFs, increasing risk of adverse respiratory health effects induced by RCFs. Interactive effect of tobacco smoking and exposure to airborne fibers previously documented. RCF-associated decreases in pulmonary function limited to current and former smokers. Finding consistent with studies of workers exposed to airborne contaminants, in which combined smoking and exposures to various airborne dusts results on increased risk of occupational respiratory diseases, including chronic bronchitis, emphysema, and lung cancer.
2013	Hexavalent chromium	Prohibit smoking in all areas of any workplaces in which workers are exposed to Cr(VI) compounds; as part of a comprehensive safety and health program, offer a no-cost smoking cessation program that informs workers about the hazards of cigarette smoking and provides assistance and encouragement for workers who want to quit smoking; all workers who smoke participate.	Entire section (8.7) devoted to smoking cessation These elements, in combination with efforts to maintain airborne Cr(VI) concentrations below the REL and prevent dermal contact with Cr(VI) compounds, will further protect the health of workers. [A]ssociation of skin disease and/or smoking habit with elevated urinary Cr levels in cement workers.

See footnotes at end of table.

(Continued)

Table A-2 (Continued). Other NIOSH Publications with Policy Recommendations Relating to Tobacco Use

Year	Agent/Process	Tobacco-related Recommendation(s)	Selected Additional Content
		Current Intelligence Bulletins	
1978	Tetrachloroethylene (perchloroethylene)	Workers who handle liquid tetrachloroethylene should wash hands thoroughly before smoking.	
1986	Methylene chloride	Smoking should not be permitted in areas where methylene chloride is manufactured, stored, or used.	
1986	4,4'-methylenedianiline (MDA)	A smoking cessation program should be provided, because cigarette smoking is a well-established risk factor for bladder cancer	
2013	Carbon nanotubes and nanofibers	Encourage workers to wash hands before eating, smoking.	
		Alerts	
1984	Carbon monoxide hazard in aircraft refueling operations	Workers engaged in fueling operations should be encouraged to refrain from smoking because smoking elevates blood levels of carbon monoxide enough to reduce margin of safety.	
1991	Lead poisoning in construction	No use or carrying of tobacco products in designated area(s); wash before smoking.*	
1992	Silicosis from sandblasting	No use of tobacco products in blasting area; wash before smoking.*	
1992	Silicosis in rock drillers	No use of tobacco products in blasting area; wash before smoking.*	
1996	Asthma from diisocyanate	Wash before smoking outside work area.	
1996	Silicosis in construction	No use of tobacco products in dusty areas; wash before smoking.*	

See footnotes at end of table.

(Continued)

Table A-2 (Continued). Other NIOSH Publications with Policy Recommendations Relating to Tobacco Use

Year	Agent/Process	Tobacco-related Recommendation(s)	Selected Additional Content
1999	Phosphine poisoning and explosions during fumigation	Wash before smoking.*	
2006	Asthma from MDI exposure during spray-on truck bed liner and related applications	Wash before smoking.*	
2007	Explosions in industrial ethylene oxide sterilization facilities	No smoking where EtO is handled, used, or stored.	
2007	Fire fighter fatalities due to heart attacks and other sudden cardiovascular events	Prohibit smoking in all fire stations and other fire department facilities; include a smoking cessation program in any wellness program.	Because not all fire stations are smoke-free, involuntary exposure to tobacco smoke continues to present cardiovascular risks for fire fighters. Unrecognized sources of carbon monoxide exposure for fire fighters include environmental tobacco smoke; diesel exhaust in firehouse; diesel exhaust from fire engine operating at fire scene.
2011	Sensitization and disease from beryllium exposure	No storage or use of tobacco products in beryllium work areas.	
Fact Sheets			
2003	Asbestos associated with vermiculite from Libby, MT	Workers who have been exposed and currently smoke should quit smoking; employers can assist them by offering smoking cessation programs.	
Workplace Solutions			
2007	Handling Micotil 300®	No smoking in designated area.	
Infosheets			
2012	Cleaning chemicals	Wash before smoking.*	

See footnotes at end of table.

(Continued)

Table A-2 (Continued). Other NIOSH Publications With Policy Recommendations Relating to Tobacco Use

Year	Agent/Process	Tobacco-related Recommendation(s)	Selected Additional Content
		Updates	
1993	Silicosis deaths	No use of tobacco products in designated area; wash before smoking.*	
		Proposed National Strategies	
1989	Proposed National Strategy for the Prevention of Occupational Lung Diseases	Management and labor should work together to develop smoking policies: • Prohibit smoking at the workplace. • Distribute information about health promotion and harmful effects of smoking. • Offer no-cost smoking-cessation classes to all workers. • Establish incentives to encourage workers to stop smoking. • Post appropriate signs at workplace entrances.	Smoking is strongly associated with many lung diseases. Smoking has an additive effect on the risk of chronic bronchitis in workers exposed to coal mine and other dusts, and it acts synergistically with asbestos to increase the risk of lung cancer. Evidence indicates adverse effects on those who are exposed to the smoke of others. Because of the overwhelming evidence of the health consequences from smoking and the number of workers affected, a focus on smoking is an important component of an effective prevention strategy. Elimination of smoking in the workplace is an effective strategy.

See footnotes at end of table.

(Continued)

Table A-2 (Continued). Other NIOSH Publications With Policy Recommendations Relating to Tobacco Use

Year	Agent/Process	Tobacco-related Recommendation(s)	Selected Additional Content
1989	Proposed National Strategy for the Prevention of Occupational Cardiovascular Diseases	Identify groups of workers at high risk of cardiovascular and other diseases based on exposure in the workplace and personal risk factors; to ensure that workers have full and effective access, implement programs for health promotion and disease prevention at the worksite whenever possible or practical; programs should include efforts to reduce personal, modifiable risk factors for cardiovascular disease, including smoking	In an ideal situation, when occupational factors increase the risk of cardiovascular disease, both occupational and personal risks would be addressed at the workplace. Encouraging workers to quit smoking is particularly important because smoking contributes not only to several cardiovascular diseases but to other diseases as well. Increasing the availability of health promotion programs in the workplace requires the cooperation of industry, labor unions, community and voluntary groups, and the government. Most programs will be conducted in the private sector, but governmental agencies can play important roles in stimulating the development of effective programs and in evaluating them.

*"Wash" in this context means wash hands and face.

To access individual documents, see NIOSH Publications and Products website, http://www.cdc.gov/niosh/pubs/default.html. Disclaimer: Table is not necessarily comprehensive. NOTE: Table does not include NIOSH recommendations focused solely on tobacco use (see Table A-1) or, for example, tobacco-related recommendations included in agent-specific guidance included in *NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards* (DHHS NIOSH Publication No. 81-123).

Table A-3. OSHA and MSHA Regulations With Provisions Relating to Tobacco Use

Hazard Category and Provisions	Agent/Process	Industry	Regulation CFR
Fire/Explosion For designated area(s): • Smoking prohibitions. and (in most listed regulations) • 'No-smoking' placard requirements. and (in some listed regulations) • Program to assure that no smoking materials are carried. and (in some listed regulations) • Smoking history required in medical surveillance.	Hydrogen Hydrogen or hydrogen sealing systems	General Industry Electric Power Generation, Transmission, and Distribution	1910.103 1910.269
	Oxygen	General Industry Surface metal/nonmetal mines Underground metal/nonmetal mines	1910.104 56.7805 57.7805
	Flammable liquids	General Industry Shipyards Marine Terminals Construction Construction Surface metal/nonmetal mines Underground metal/nonmetal mines 	1910.106 1915.36 1917.156 1926.152 56.4100 56.4101 57.4100 57.4101
	Spray finishing using flammable and combustible materials	General Industry Marine Terminals	1910.107 1917.153
	Explosives and blasting agents	General Industry Surface metal/nonmetal mines Underground metal/nonmetal mines Underground coal mines 	1910.109 1926.900 1926.902 1926.904 56.6904 57.6904 75.1702 75.1721
	Storage and handling of liquefied petroleum gases	General Industry	1910.110

See footnotes at end of table.

(Continued)

Table A-3. OSHA and MSHA Regulations With Provisions Relating to Tobacco Use (Continued)

Hazard Category and Provisions	Agent/Process	Industry	Regulation CFR
	Dipping and coating operations that use flammable liquids or liquids with flashpoints greater than 199.4 ˚F (93 ˚C)	General Industry	1910.125
	Battery-charging/changing areas	General Industry	1910.178
		Surface metal/nonmetal mines	56.4502
		Underground metal/nonmetal mines	57.4502
		Marine Terminals	1917.157
		Longshoring	1918.1
	Grain handling facilities	General Industry	1910.272
	Permit-required Confined Spaces	General Industry	1910.146
	Underground lines	Power Transmission and Distribution	1926.956
	Benzene	General Industry	1910.1028
		Shipyards	1915.1028
		Construction	1926.1128
	Acrylonitrile	General Industry	1910.1045
		Construction	1926.1145
	Ethylene oxide	General Industry	1910.1047
		Construction	1926.1147
	Formaldehyde	General Industry	1910.1048
		Shipyards	1915.1048
		Construction	1926.1148
	Gassy operations	Underground Construction Caissons, Cofferdams, and Compressed Air	1926.800
		Underground metal/nonmetal mines	57.22102
			57.22105

See footnotes at end of table.

(Continued)

Table A-3. OSHA and MSHA Regulations With Provisions Relating to Tobacco Use (Continued)

Hazard Category and Provisions	Agent/Process	Industry	Regulation CFR
	General Fire Prevention	Construction	1926.151
		Underground metal/nonmetal mines	57.4100
			57.4101
			57.6904
			57.7805
			57.22101
			57.22102
		Underground coal mines	77.1102
			77.1711
	Record-keeping areas	Underground metal/nonmetal mines	57.5041
Ingestion/absorption of toxic agent For designated area(s): • Prohibitions on smoking, storage of smoking materials, tobacco products (including chewing tobacco), and chewing of such products. and • Requirements for washing prior to smoking/eating. and (in most listed regulations) • Requirements to post "No-smoking" placards.	Asbestos	General Industry	1910.1001
		Shipyards	1915.1001
		Construction	1926.1101
	13 specified carcinogens (4-Nitrobiphenyl, etc.)	General Industry	1910.1003
		Shipyards	1915.1003
		Construction	1926.1103
	Inorganic arsenic	General Industry	1910.1018
		Shipyards	1915.1018
		Construction	1926.1118
	Lead	General Industry	1910.1025
		Shipyards	1915.1025
		Construction	1926.62

See footnotes at end of table.

(Continued)

Table A-3. OSHA and MSHA Regulations With Provisions Relating to Tobacco Use (Continued)

Hazard Category and Provisions	Agent/Process	Industry	Regulation CFR
	Chromium (VI)	General Industry	1910.1026
		Shipyards	1915.1026
		Longshoring	1918.1
		Construction	1926.1126
	Cadmium	General Industry	1910.1027
		Shipyards	1915.1027
		Construction	1926.1127
		Agriculture	1928.1027
	Benzene	General Industry	1910.1028
		Shipyards	1915.1028
		Construction	1926.1128
	Coke oven emissions	General Industry	1910.1029
		Construction	1926.1129
	Bloodborne pathogens	General Industry	1910.1030
		Shipyards	1915.1030
	1,2-dibromo-3-chloropropane	General Industry	1910.1044
		Shipyards	1915.1044
		Construction	1926.1144
	Acrylonitrile	General Industry	1910.1045
		Construction	1926.1145
	Ethylene oxide	General Industry	1910.1047
		Construction	1926.1147
	Ethylene oxide	General Industry	1910.1047
		Shipyards	1915.1047
	Formaldehyde	General Industry	1910.1048
		Shipyards	1915.1048
		Construction	1926.1148

See footnotes at end of table.

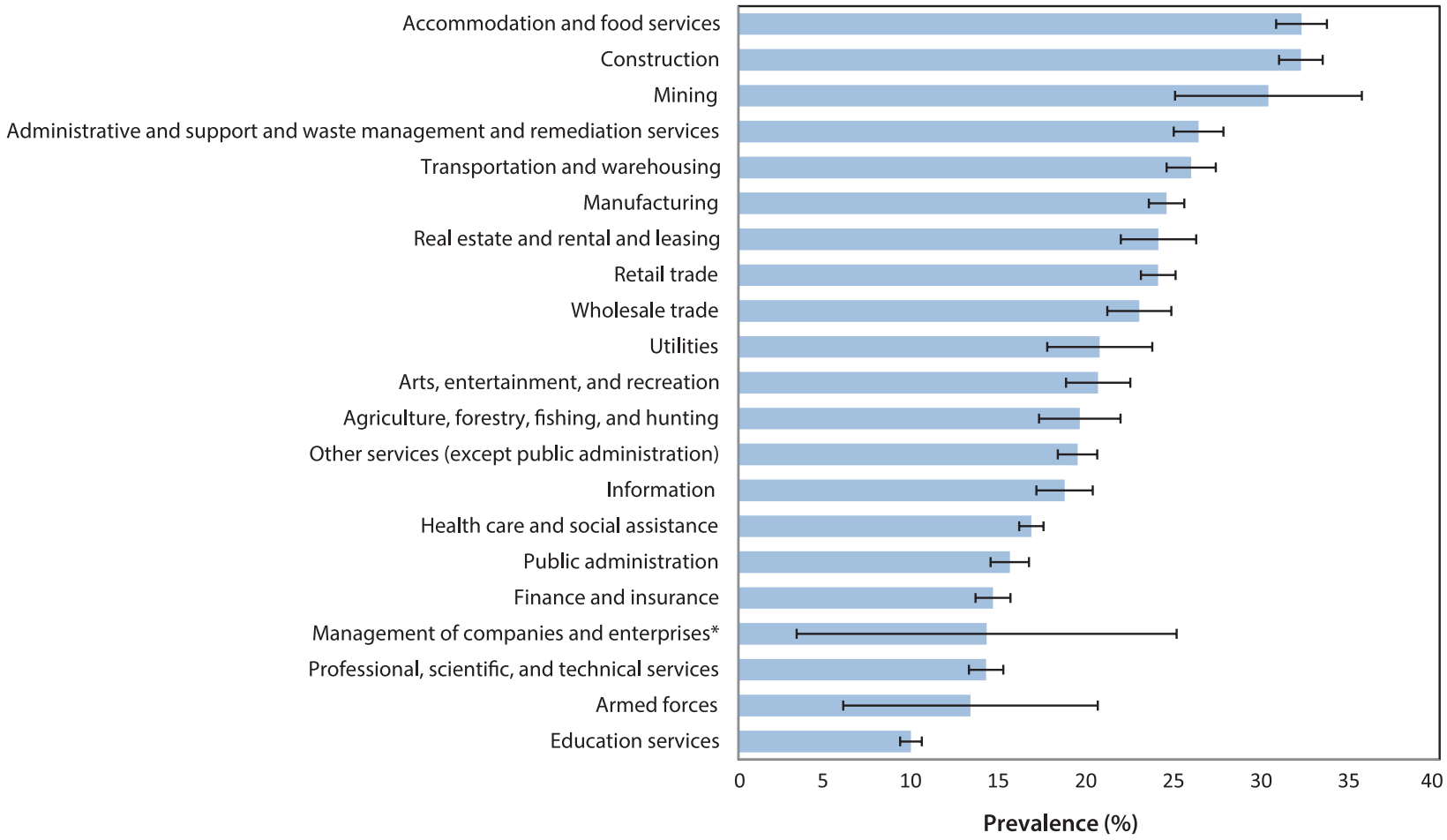
(Continued)

Table A-3. OSHA and MSHA Regulations With Provisions Relating to Tobacco Use (Continued)

Hazard Category and Provisions	Agent/Process	Industry	Regulation CFR
	Methylenedianiline	General Industry	1910.1050
		Shipyards	1915.1050
		Construction	1926.60
	1,3-Butadiene	General Industry	1910.1051
	Methylene chloride	General Industry	1910.1052
		Shipyards	1915.1052
		Construction	1926.1152
	Hazardous chemicals in laboratories	General Industry	1910.1450
		Shipyards	1915.1450
	General/Field Sanitation	Shipyards	1915.88
		Agriculture	1928.110
Misc. • Personal Protective Equipment Standard: requires a 15-minute no-smoking period prior to Bitrex fit-testing of respirators. • Cotton Dust Standard: required medical questionnaire asks about smoking. • Hazard Communication Standard: Appendices invoke smoking history in the assessment of evidence used to categorize substances as respiratory sensitizers, and detail requirements for "No smoking" warning labels.	Personal Protective Equipment	General Industry	1910.134
		Shipyards	1915.154
		Marine Terminals	1917.92
		Longshoring	1918.102
		Construction	1926.103
	Cotton Dust	General Industry	1910.1043
	Hazard Communication	General Industry	1910.1200
		Shipyards	1915.1200
		Construction	1926.59

Specific requirements of OSHA and MSHA regulations should be determined by directly consulting those regulations. Disclaimer: Table is not necessarily comprehensive and is not intended to be used for compliance purposes. NOTE: Table does not include OSHA regulations that require retention of Department of Transportation markings, placards, and labels relating to flammability/explosivity (e.g., 1910.1201, 1915.88, 1917.29, 1926.61). Nor does it include OSHA "model standards" for carcinogens (1990.151; 1990.152), which include a provision prohibiting smoking/chewing/tobacco.

Figure A-1a. Cigarette smoking among working adults, by industry—United States, 2004–2010



Adapted from: NIOSH [2014]. *Estimates for industries with asterisks are statistically unstable due to large standard error. The black lines on this figure, and those that follow, represent the 95% confidence interval for each displayed point estimate.

Figure A-1b. Cigarette smoking among working adults, by occupation—United States, 2004–2010

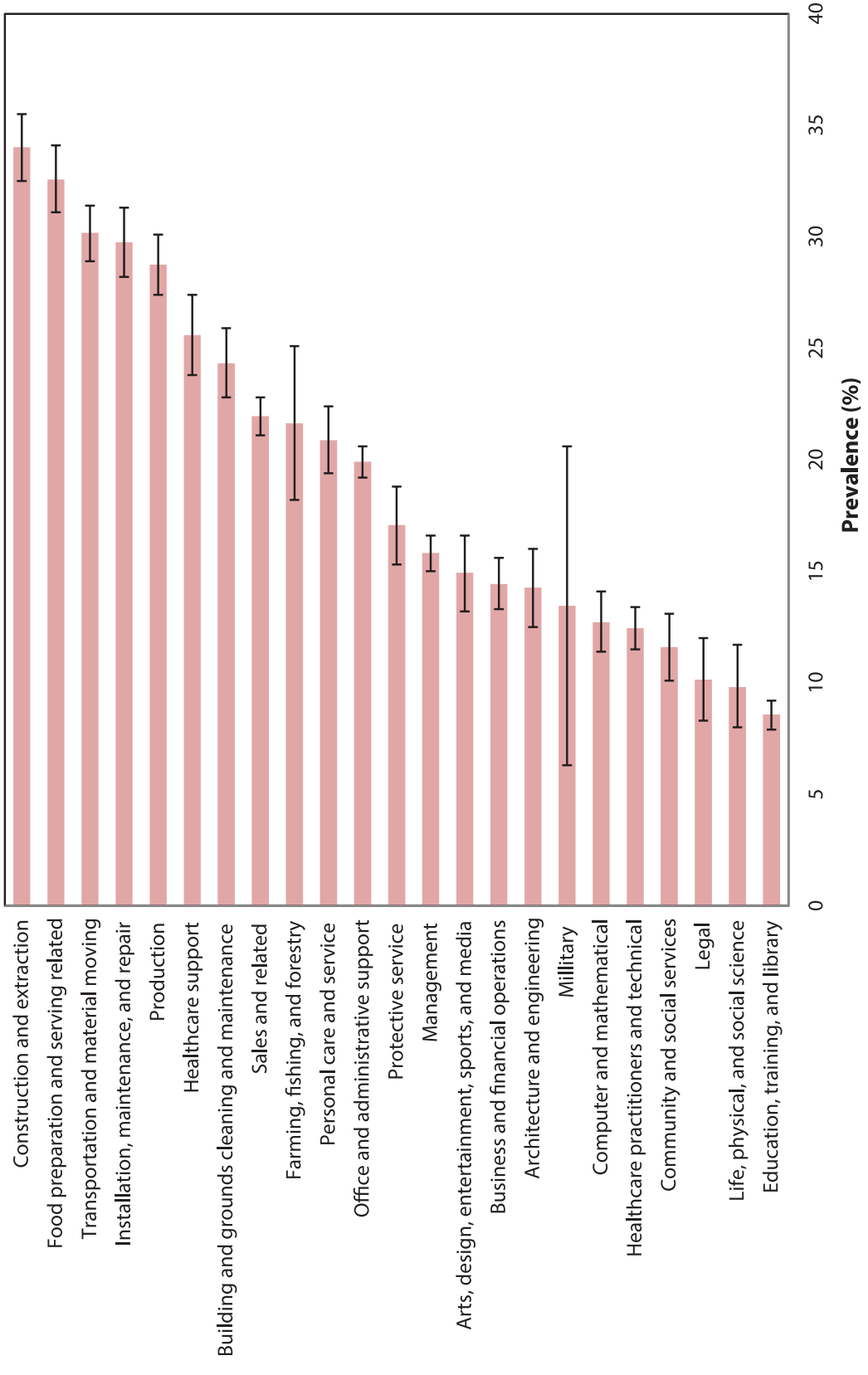
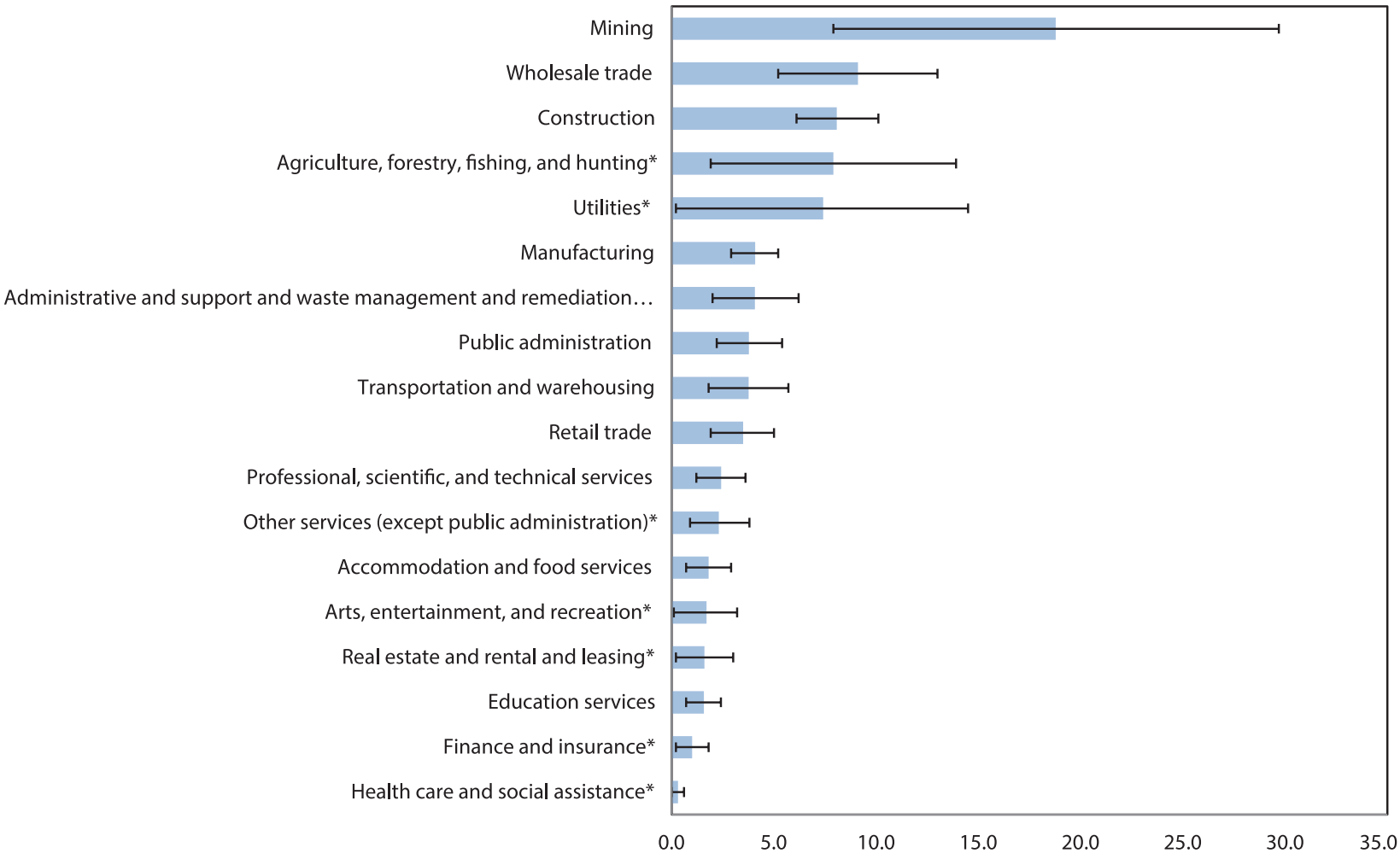
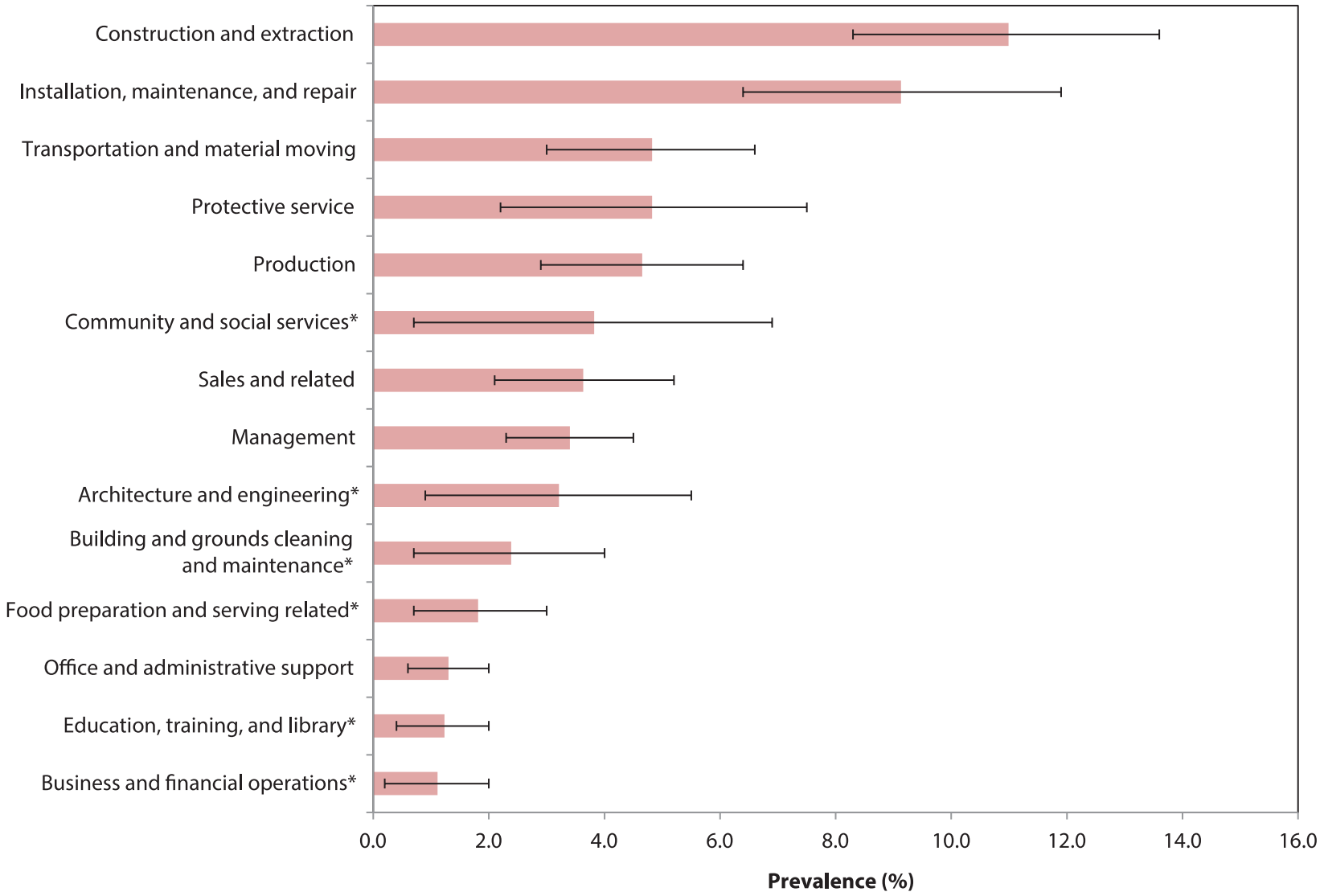


Figure A-2a. Smokeless tobacco use among working adults, by industry—United States, 2010



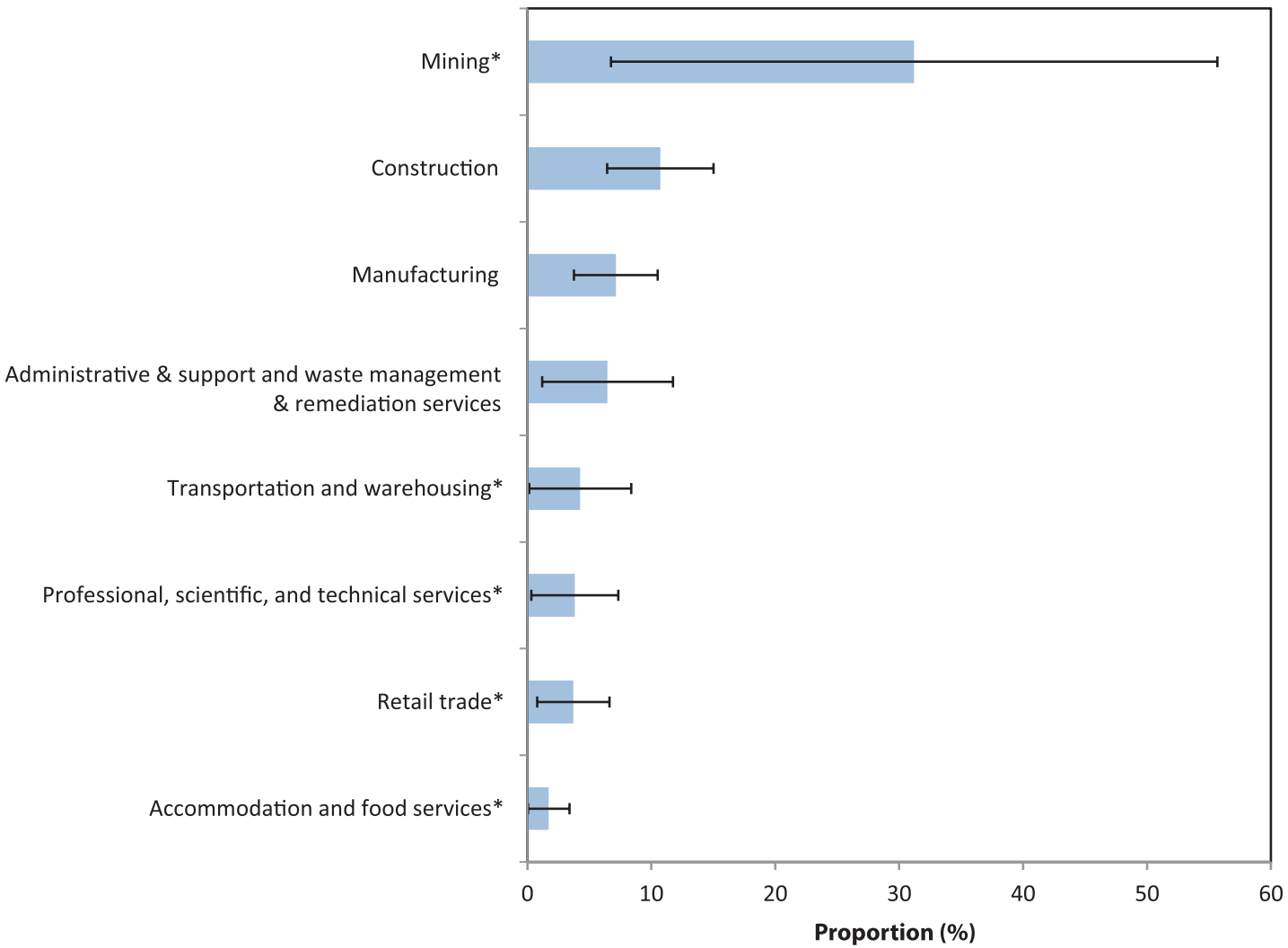
Adapted from: NIOSH [2014]. *Estimates for industries with asterisks are statistically unstable due to large standard error.

Figure A-2b. Smokeless tobacco use among working adults, by occupation—United States, 2010



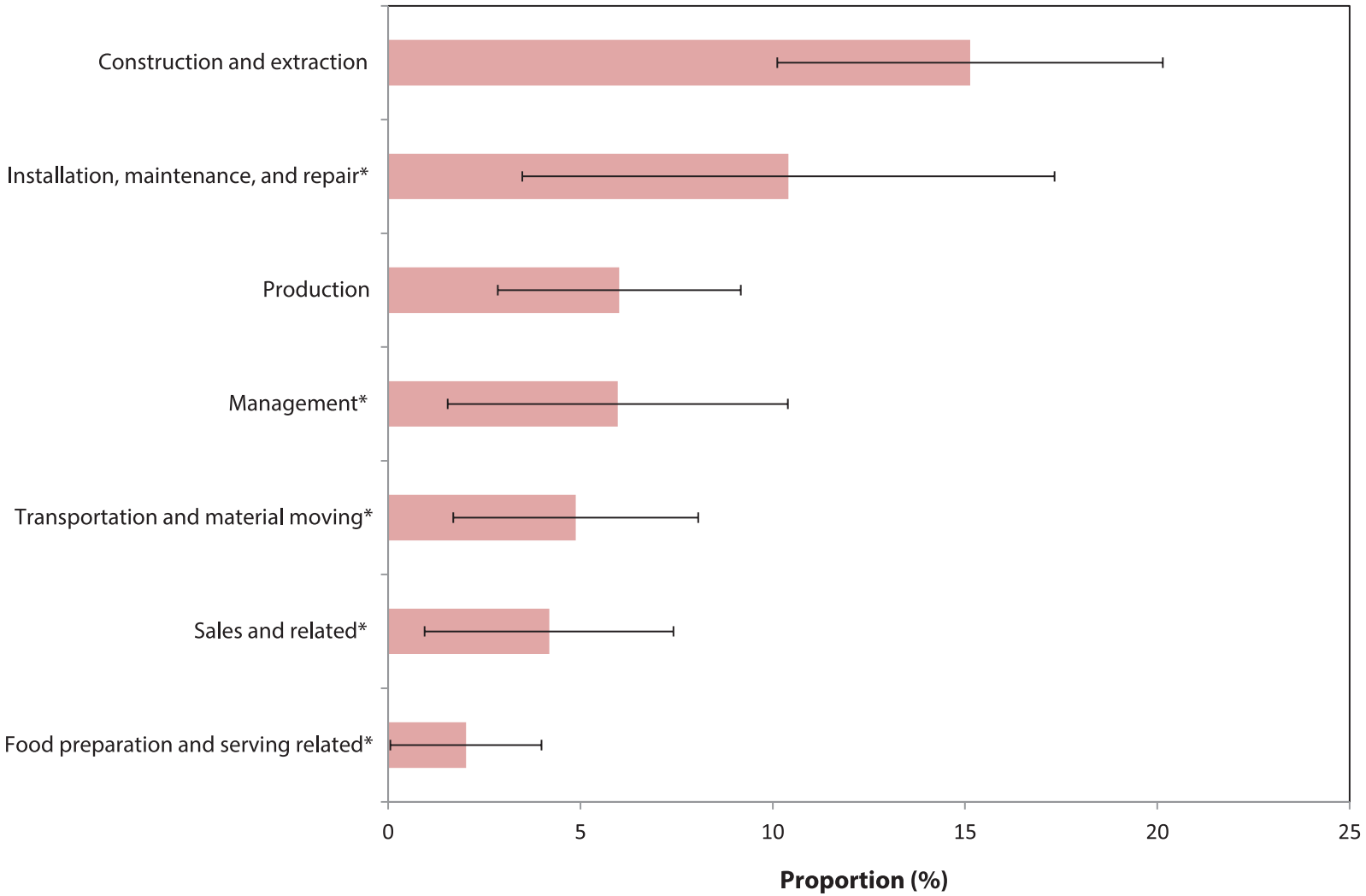
Adapted from: NIOSH[2014]. *Estimates for industries with asterisks are statistically unstable due to large standard error.

Figure A-3a. Dual use of tobacco: Proportion of cigarette smokers who also use smokeless tobacco among working adults, by industry—United States, 2010



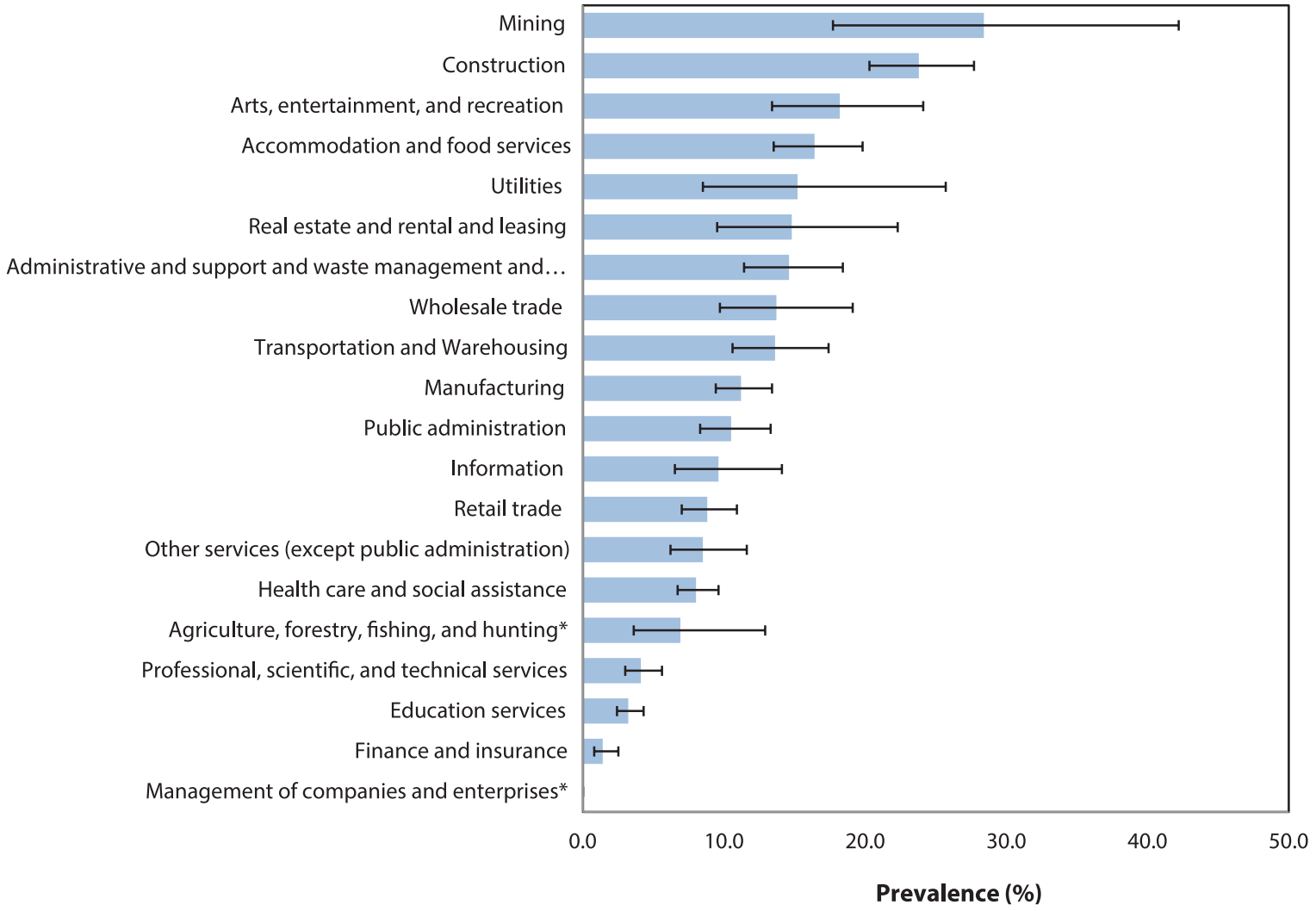
Adapted from: NIOSH[2014]. *Estimates for occupations with asterisks are statistically unstable due to large standard error.

Figure A-3b. Dual use of tobacco: Proportion of cigarette smokers who also use smokeless tobacco among working adults, by occupation—United States, 2010



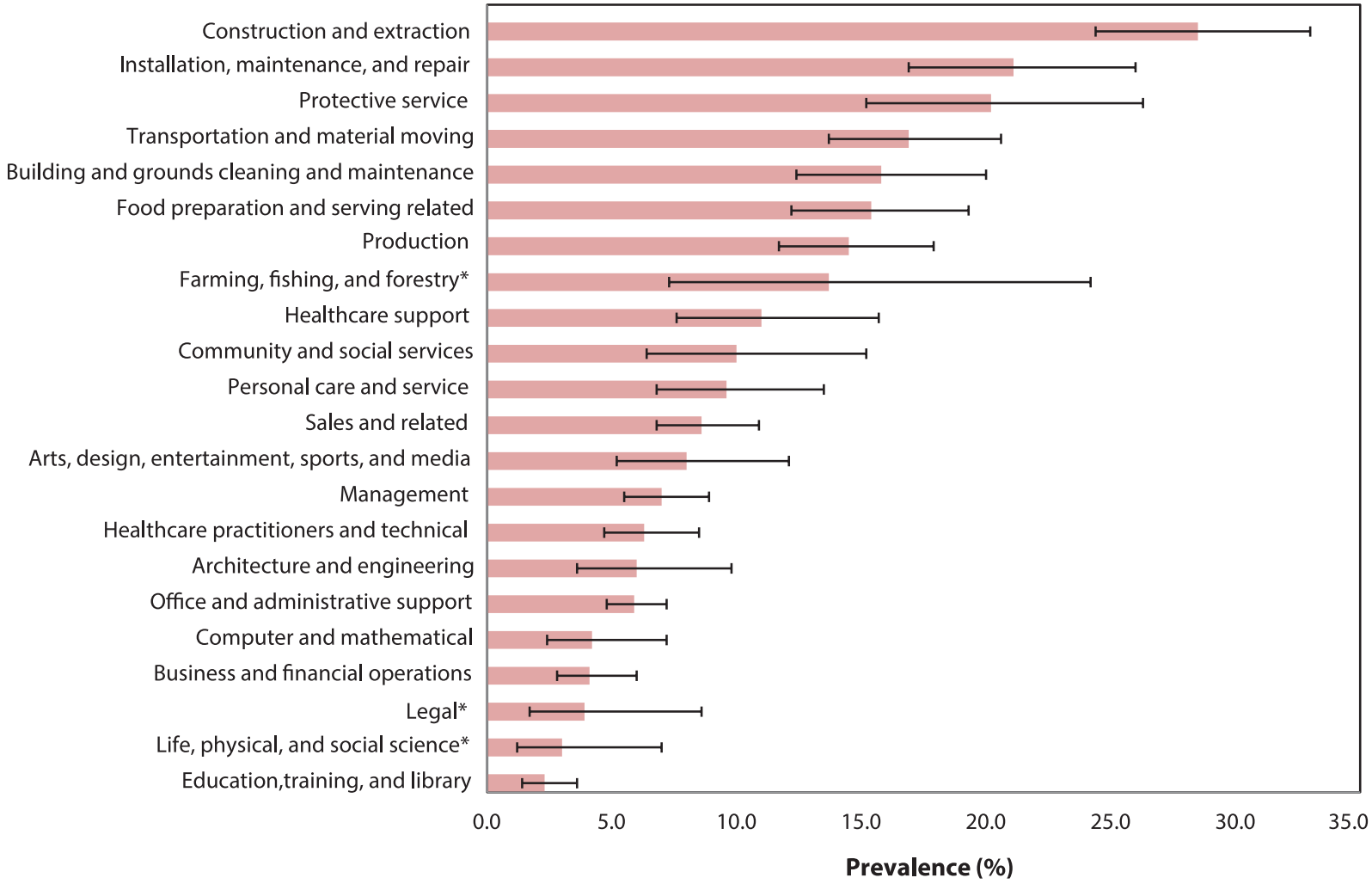
Adapted from: NIOSH[2014]. *Estimates for occupations with asterisks are statistically unstable due to large standard error.

Figure A-4a. Prevalence of frequent exposure to SHS at work among nonsmoking adults who worked in the past 12 months, by industry—United States, 2010



Adapted from: Calvert et al. [2013]. *Estimates for industries with asterisks are statistically unstable due to large standard error.

Figure A-4b. Prevalence of frequent exposure to SHS at work among nonsmoking adults who worked in the past 12 months, by occupation—United States, 2010



Adapted from: Calvert et al.[2013]. *Estimates for occupations with asterisks are statistically unstable due to large standard error.

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